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THE UNIVERSITY OF ALBERTA

THE EFFECT OF PRIOR PLAY EXPERIENCE ON YOUNG CHILDREN'S PROBLEM SOLVING

by

© JOYCE ELLEN RICE

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled The Effect of Prior Play Experience on Young Children's Problem Solving submitted by Joyce Ellen Rice in partial fulfilment of the requirements for the degree of Master of Education.

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Date 19th September, 1977

Abstract

The purpose of this study was to examine the effect of different prior play experiences upon children's problem solving. Two stimulus materials, Animal Groups and Cargo Groups, designed by Nelson and Sawada (1975) were used as both play and testing materials.

The subjects in the study were kindergarten children from two schools in the Edmonton Public Schools System. A sample of 45 children was randomly selected, then randomly assigned to one of three treatment groups: Control Group, Free Play and Augmented Play. Subjects from the two play groups visited the playroom individually for 15 minutes on each of 3 days. On the 4th and 5th days, subjects were tested on four problems, two measurement division and two partitive division problems. The Control Group subjects were tested prior to the experiment. All proceedings were videotaped.

A one-way analysis of variance revealed no significant effects of the play treatments on the eight dependent variables. Two-way analyses of variance were conducted to examine the combined effects of treatment and three independent variables. The significant results are reported. A three-way analysis of variance revealed no further significant main effects of treatment, school or time of kindergarten session.

Correlations between pairs of the eight dependent variables were conducted. Several significant relationships led to further analysis of the influence of play levels.

A rough categorization was made of the play behavior of six subjects scoring lowest scores and six subjects scoring highest scores in the four test problems. A relationship was noted between the level of play exhibited by these subjects and the scores achieved on the test problems. Among the 12 subjects, higher level scorers had a mean age six months higher than the mean age of lower level scorers.

Lower level scorers seemed to exhibit a lower level of play, of a sensory-motor manipulative nature, giving responses which appeared to be suggestive of the nature of the play materials. Periods of symbolic play behavior observed appeared to be fragmentary, largely representational in nature and unrelated to one another. These subjects seemed to show less concentration on the play materials and greater subjectivity in play than higher level scorers.

Higher level scorers seemed to exhibit more symbolic play and more constructive behavior in building a theme. Subjects appeared to have greater concentration within play, give more diverse responses and plan more objective play sequences than lower level scorers.

A number of conclusions are reported and implications for further study are suggested.

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TABLE OF CONTENTS

CHAPTER PAGE

I INTRODUCTION TO THE INVESTIGATION............. 1
  - Purpose of the Study..................... 4
  - The Background to the Study.............. 5
  - Definitions.............................. 6
  - Significance of the Study................ 7
  - Limitations of the Study................. 8

II CONCEPTUAL FRAMEWORK AND REVIEW OF RELATED LITERATURE................................. 10
  - The Child's Representation of Experience. 10
  - The Growth of Cognition.................. 11
    - The Role of Experience.............. 11
    - The Role of Representation.......... 12
    - Play Conditions for Cognitive Growth 12
  - Modes of Behavior in Play................ 15
    - Imitation........................... 16
    - Exploration......................... 16
    - Testing............................. 17
    - Construction........................ 18
  - Stages of Play in Preschool Children..... 18
    - Practice Play....................... 19
      - Sensory-Motor Play.............. 19
      - Manipulative Play............... 20
    - Symbolic Play....................... 20
      - Representational or Role Play.. 20

CHAPTER PAGE

Dramatic or Thematic Play...... 20

The Relationship of Play to Problem Solving................................ 22

Play as a Medium for Problem Solving..... 23

Research........................... 26

Divergent Thinking...................... 28

Research........................... 30

Abstract Thinking........................ 32

Research........................... 34

The "As If" Role of Imagination.......... 35

Research........................... 36

Summary................................. 38

Research Hypotheses...................... 39

Research Questions....................... 41

III RESEARCH PROCEDURES........................ 43

Summary of the Research Design........... 43

The Pilot Study.................... 44

The Sample......................... 46

The Setting........................ 47

Preparation of the Subjects......... 48

The Play Sessions.................. 48

Intervention in the Augmented Play Group.............................. 49

The Testing Sessions............... 50

The Stimulus Materials.................. 51

Animal Groups...................... 51

CHAPTER PAGE

The Problems........................ 52

Cargo Groups........................ 52

The Problems........................ 53

Difficulties Experienced During the Experiment...................... 54

Analysis of the Data.................... 54

Inter-Rater Reliability of Scoring. 55

Reliability of the Response Categories.................. 55

Reliability of Scoring the Responses.................. 56

The Categories.......................... 58

Animal Groups....................... 58

Measurement Division.......... 58

Partitive Division............ 61

Cargo Groups........................ 63

Measurement Division.......... 63

Partitive Division............ 65

Statistical Analysis.................... 67

Summary................................ 67

IV ANALYSIS AND RESULTS

One-Way Analysis of Variance............ 69

Hypothesis: The Effect of the Treatment........................... 69

Results....................... 70

Discussion.................... 73

CHAPTER PAGE

Correlations Among Dependent Variables... 78

  Hypotheses: Correlation of Scores and Times.......................... 78

  Results.......................... 78

  Discussion.......................... 80

Two-Way Analysis of Variance............ 81

  Hypotheses: Independent Variables.. 81

  Results.......................... 82

  Discussion.......................... 85

    The Effect of School........... 85

    The Effect of Order............ 88

Research Questions...................... 89

Relationship of Scores to Play Behavior.. 90

  Subjects Achieving Lowest Scores.... 90

  Subjects Achieving Highest Scores... 91

Features of Play Behavior............... 92

  Lowest Scoring Subjects............. 92

    Modes of Behavior.............. 92

    Objectivity................... 93

    Concentration................. 93

    Problems...................... 94

    Diversity of Responses......... 94

  Highest Scoring Subjects............ 95

    Modes of Behavior.............. 95

    Objectivity................... 95

    Concentration................. 96

CHAPTER PAGE

Problems.................... 96
Diversity of Responses....... 97
Comparison of Ages............... 97
Discussion....................... 98
Relationship of Play Level... 99
Effect of Age............... 100
Perceptual Distractions...... 101
Conclusions........................... 101
V CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH...................... 103
Conclusions of the Study.............. 104
Implications for Education, Research and Teacher Education.................. 106
Additional Research Considerations..... 109
The Effects of Time and Complexity of Play Setting.................. 109
The Effect of Play on Diverse Problems......................... 110
The Effect of Socialization....... 110
Additional Variables............. 111
Play Level....................... 111
BIBLIOGRAPHY................................... 112
APPENDIX A..................................... 117
APPENDIX B..................................... 123
APPENDIX C..................................... 126
APPENDIX D..................................... 128

CHAPTER PAGE

APPENDIX E.................................... 133
APPENDIX F.................................... 138
APPENDIX G.................................... 141
APPENDIX H.................................... 144
APPENDIX I.................................... 147
APPENDIX J.................................... 152

LIST OF TABLES

Table Page

1 Inter-Rater Reliability of Categorization of Responses 57

2 One-Way Analysis of Variance on the Eight Dependent Variables 71

3 Means and Standard Deviations of Treatment Groups on Eight Dependent Variables 72

4 Correlation Matrix: Eight Dependent Variables 79

5 Scores on Problem 4 (Effect of school by treatment) 83

6 Times on Problem 2 (Effect of school by treatment) 84

7 Scores on Problem 2 (Effect of order by treatment) 86

LIST OF FIGURES

Figure		Page
1	Scores on Problem 4 (Effect of school by treatment)	83
2	Times on Problem 2 (Effect of school by treatment)	84
3	Scores on Problem 2 (Effect of order by treatment)	86

CHAPTER I

INTRODUCTION TO THE INVESTIGATION

> The path from play to internal processes in school age - endophasia, association, logical memory, abstract thinking (without things, but in concepts) - is the main path of development; one who understands this connection understands the main element in the transition from preschool to school age. Vygotsky (cited in El'Konin, 1971, p. 230).

Early childhood education in the 1970's has assumed new significance in the fields of education and psychology as the period of the most rapid growth in a child's intellectual development. Bloom (1964) concluded that by about age eight, 80% of a child's general intelligence had already developed. Support from Jensen (1967) and Hunt (1961) indicated that the environmental influence or experience during the early childhood years is vital for later cognitive growth. The characteristic experience of children who achieve age-appropriate competence has been identified by White et al (1973) as an enriched play environment where the child freely explores in a constantly motivating world and a supportive family.

Concomitantly, theory shows that children grow along clearly defined stages of development (Bruner, 1960; Erikson, 1963; Piaget & Inhelder, 1969; Vygotsky, 1962).

Emerging from this knowledge, matched by the research showing how children learn, and the recognition that children are capable of much more than was previously thought, is a new emphasis on cognitive development in the early childhood curriculum, together with a re-evaluation of the real goals of education.

In the period from three years to eight years, the primary activity of children is play. Numerous writers (Almy, 1967; Arnaud, 1974; Biber, 1971; Isaacs, 1933; Sutton-Smith, 1971; Vygotsky, 1966) comment on the natural learning which occurs during play. First, play allows the child to satisfy his curiosity, then leads him to explore the world around him. The result of this exploration is discovery, but more importantly, self-discovery of concepts which become the basis of the child's learning. What is discovered is delightedly repeated, affording the practice essential to any learning process. In effect, play is the child's work, the process by which he, as the active participant, explores his environment.

The necessary ingredients which give the child opportunity for self-inquiry and discovery would appear to be the features which teachers should provide in early childhood programs. According to Piaget, explained by Duckworth (1964)

> good pedagogy must involve presenting the child with situations in which he himself experiments ... trying things out to see what happens,

> manipulating things, manipulating symbols, posing questions and seeking his own answers. (p. 2)

Suchman (1964) described these ingredients. Firstly, the child needs a problem, or a stimulus, on which he can focus, one which cannot be solved easily. Secondly, he must be given the freedom to discover the solution for himself. Thirdly, to aid the discovery process, the environment needs to be responsive, that is, giving immediate feedback to his actions.

Child's play seems to be a sensible base for this kind of learning. Almy (1967) agreed when she strongly urged that the learning environment of young children match the way in which children think. No two children have the same life experiences upon which to interpret reality. According to Duckworth (1964), Piaget's definition of true learning requires activity by oneself to fit the new discoveries to one's previous experience. This individual nature of the child's learning is best provided in an environment where the child can determine what sense he makes out of his world.

Definite cognitive advantages accrue from play (Arnaud, 1974; Sutton-Smith, 1971), including problem solving facility. Research in this area however is limited, dealing mostly with the value of sociodramatic play programs, typically of a long duration, upon social problem solving skills and general cognitive gains of disadvantaged children. Little research exists to show the value of the child's play with specially planned materials upon problem solving ability requiring a specific solution. In playing with such materials, children will probably meet many problems for which they must find an answer, as well as constantly reorganizing their understanding of basic physical concepts. One might ask, do the actions of children in play have any bearing upon the solving of a task requiring a specific answer, and if so, what is it in the play that helps children to solve problems? It was to these questions that this study was directed.

Purpose of the Study

In general terms, the purpose of this investigation was to gain information on the effect of three prior play experiences upon consequent solving of four nonverbal mathematical problems by children in kindergarten. The main purpose of the study was to observe, record and categorize in numerical form, the responses of the subjects to the problems and then to compare the play behavior of children in the experimental play groups. The results were subjected to statistical analysis to compare the effects of each of the three treatments. The responses to be categorized consisted of the subjects' manipulative actions upon the problem materials and the solutions to the problems.

Secondly, from the play behavior were sought characteristic elements of children's play which might relate to an ability to solve problems of a specific nature.

The Background to the Study

Nelson and Sawada (1975) developed a series of concrete real-life stimulus materials designed as testing situations for non-verbal problem solving in mathematics. Using two of these materials, Bourgeois (1976) noted that a number of distractions seemed to prevent children under six years of age from obtaining a solution in the problems he posed. These distractions were, playing with the materials, classifying of the objects according to perceptual qualities, using motoric and affective behavior and being affected by prior responses when attempting to solve the problem. The behavior of the subjects during the problem solving appeared to the researcher to fit the definition of manipulative play. Perhaps a period of time should be allowed for children to play with the materials in order to overcome these distractions and solve the problems.

In a study by Sylva, Bruner and Genova (1976), of mechanical problem solving, prior play experience led children to discover the principle by which to solve the problem. The characteristic feature of the problem solving procedure of the play group over other subjects was the logical growth towards a solution using a simple to complex sequence. The ability to use sequential activity in problem solving might be related to the ability of children to develop a theme as in symbolic or dramatic play. Perhaps teachers might effectively guide children from one level of play onto further levels by adding suggestions, by questioning, by joining in the play with the child and by demonstrating how to play.

Definitions

Free Play. All the actions, freely chosen by the subjects, after they are invited to interact with the stimulus materials.

Augmented Play. Free play in which an adult prompts a child to enlarge on the ways in which he uses the play materials, through questions, suggestions or demonstrations.

Manipulative Play. Sensory-motor actions upon the materials by the subject. Activities include handling of the objects, exploring their use and appearance, and classifying the materials in a fashion which can be recognized as perceptual in nature, e.g. by color or by family.

Symbolic Play. Play in which the child uses the materials to represent something else during the process of developing his play as a series of activities around a common theme.

The following definitions referred to the testing sessions and were taken from the study by Bourgeois (1976).

Measurement Division. A measurement division problem is one in which the number of subsets is to be determined when a given set of elements is separated into equivalent subsets.

Partitive Division. A partitive division problem is one in which the number of elements in each subject is to be determined when a set of elements is separated into a given number of equivalent subsets.

Problem Situation. All aspects of the materials designed for the problem.

Problem. A verbal statement about the apparatus requiring a response from the subject.

Significance of the Study

Play is being recognized for evidence of its cognitive gains for the child. A truly personal learning medium, children test through practice in play, individual concepts, formed as they order their experience into a framework of reality. In addition, personal frustrations which form barriers to learning are released during play, so that the child is more able to become absorbed in his activity.

This study is also significant because ways are suggested in which teachers may use play as a problem solving device in the kindergarten program. Further, at the same time, teachers may direct children's play towards the learning of basic concepts necessary for later symbolic learning.

Further, significance lies in the need for further research in this field, especially in testing out over lengthy periods of time, the value of play upon problem solving in a number of disciplines, such as mathematics. Secondly, it may extend knowledge of the learning processes of children in play.

Limitations of the Study

1. No attempt was made to obtain background information on the subjects.
2. The unfamiliar presence of the researcher and the movements of the videotape equipment might have affected the performances of the subjects.
3. During the taping of the data, the subjects were confined to a relatively small area.
4. The videotape data of the problem testing sessions was incomplete because of a mechanical fault, so scores and procedures in these sessions were analyzed from written records taken by the researcher.
5. The behaviors in this study reflected the behaviors of kindergarten children in the experimental schools only and may not be generalized to the kindergarten population.
6. The problems presented to the subjects were task specific and might not be indicative of the subjects'

ability in a wider range of mathematical or other problems.

CHAPTER II

CONCEPTUAL FRAMEWORK AND REVIEW OF RELATED LITERATURE

Chapter II is divided into two main sections. The first section sets out a conceptual framework developed from research and theory upon which the study is based. In this framework, the value of play in the development of problem solving ability is examined. The second section states the hypotheses which are the focus of the study.

The Child's Representation of Experience

The process of cognizing one's world is the process of coming to know and understand that world. Duckworth (1964) wrote that in Piaget's view

> an individual comes to see the world as coherent, as structured, to the extent that he acts upon the world, transforms it, and succeeds in coordinating these actions and transformations. (p. 2).

Problem solving is a cognitive process requiring the child to draw from a store of past experience in order to solve a problem. Although the preschool child has internalized a growing amount of knowledge, he often lacks the symbolic means of representing this knowledge. During the years from infancy to about age seven, play is the major means at his disposal for both internalizing new knowledge and representing that knowledge through action. In addition, through action the child meets and solves a number of problems which occur naturally in his play.

The Growth of Cognition

The Role of Experience

The young child's growth in cognition from infancy occurs through the process of learning to differentiate, firstly between himself and his environment, and secondly between his subjective and objective self (Werner & Kaplan, 1963). This growth in differentiation is indicated also in the growth of the child's concrete thought towards abstract thought. His initial contact with and learning about objects in his world occurs in a secure affective relationship with his mother, but he is soon lured towards knowing the social world to which she belongs. He does this through action.

In order to understand his world, the child must develop a structure of knowledge about it. Four factors, in Piaget's view, propel him towards cognitive development, social transmission, maturation, experience and equilibration (Piaget, 1964). Of particular importance to problem solving are the latter two. Two kinds of experience are identified by Piaget (1966, p. v-vi), physical experience where the child acts "upon objects in order to find out something from the objects themselves," and logico-mathematical experience where knowledge is "derived from the actions which transform the objects and not from the objects themselves." In the continual coordination of the child's actions are the roots of thought and intelligence.

At the heart of Piaget's theory is equilibration, the continual self-regulation of the child of his actions and his internalized mental operations. Two processes, assimilation and accommodation, work continually to achieve equilibrium whenever contradictions occur in the child's experience. In this way his cognition grows.

The Role of Representation

Manipulative sensory-motor exploration of objects are the first actions through which the child discovers the qualities and functions of objects. As he reaches new stages of development, at the preschool age, his social world is enlarged and he experiences new desires which cannot be realistically fulfilled. Consequently he experiences feelings of dissatisfaction and when the opportune moment arises, represents his unfulfilled desires in play.

According to Gross (1974, p.13), representation "is the translation of an experience, an idea, a feeling into symbols." In play, representation arises from two sources, the child's desire to experience pleasurable situations and his need to make sense of new experience. At this stage of his development, because he lacks adequate language, full symbolic thought is as yet beyond him. Thus his expression of his wishes and his experience is achieved through his whole body in action, sensations and images. To those who seek knowledge of the child's cognitive growth, these symbolic representations, particularly in play, may mirror the internal processing of information by the child, or his thinking as he develops a structure of knowledge through experience. New ideas which are incorporated into the child's schema are used by him in his creation of play situations where he experiments and plans. Without realizing it, the child practises and masters new skills and forms new concepts in patterning his experience of the real world. In the growth of cognition, play becomes important as the intermediate place between the child's subjective impressions and the symbolic world (Hartley, Frank & Goldenson, 1952).

Play Conditions for Cognitive Growth

Representation is facilitated by positive conditions for cognitive growth which exist in play.

Within play, the child experiences both a physical and psychological freedom. Not only is he "free" to act within his own physical domain which is a miniature imitation of an adult world, but in his mind, his choice of actions is unlimited. Right and wrong are non-existent and all things are possible, although as Vygotsky (1966) wrote, the child's actions will be guided by internal rules inherent in the play situation. Consequently there exists an openness in the child's mind towards new experiences, and new possibilities which result in the broadening of all his skills.

Psychologically also, he achieves freedom from adult control which is exerted when he intrudes into the real world or oversteps his body and mind's "executive capacity" (Erikson, 1963). Guilt feelings, resulting from a failure to achieve the expectancies of the adults in his world, are removed and tension is lessened. Within his play he experiences no traumatic failure which might prevent him learning. The only constraints upon his actions are environmental or self-imposed.

Another positive aspect of the play environment is that the child initiates his own activity. In doing so, he exhibits a purposeful face towards play. He becomes decision-maker and soon play-master, and in this position, achieves confidence and autonomy (Caplan & Caplan, 1974, p. 239). By planning his own activity and setting his own boundaries for action, independence also grows. Thus, in educational settings, the teacher who directs the child's cognitive learning, ensures the voluntary nature of his play by tactful and sensitive intervention.

Play allows for the uniqueness of each child so that individual learning results (Weininger, 1977). No two children have identical needs, physically, emotionally or mentally, nor the same experience. The play environment allows for individual pace, practice and new motivations, provided an adult constantly ensures that new materials are present to excite curiosity and provide exploratory opportunities amid familiar materials. Only the child can decide when he has satisfactorily assimilated information and is ready to attempt new concepts.

To the child, the most important thing about his play is the enjoyment he experiences, and satisfaction in his ever-increasing capacity to master his own destiny. This, together with the freedom he feels within play, results in a bonus which has a major effect on learning, particularly in problem solving. The child becomes absorbed in his activity as every facet is riveted in close attention on the task he has set himself. The result is that he is able to give "free attention" to an activity such as problem solving as noted by Sylva et al (1976).

Modes of Behavior in Play

Sutton-Smith (1972) identified "four modes of playful knowing", imitation, exploration, testing and construction, which might be called four modes of behavior in play. Each of these he suggested, is an "epistemological precursor of the four-fold theories of truth: correspondence, causal, predictive and coherence." (p. 33). In the enjoyment of play, using these modes, the child transforms his experience and gains greater cognitive control of his world.

Each of these modes of behavior is more complex than the other and grows in diversity at all stages of children's play. Therefore they may be regarded as growing spirally at each new stage of cognitive development and observable in play.

Imitation

Imitation is the first indication that the child has selectively chosen to copy an action of something, or to model a person in play. He has reached a stage where he is ready to borrow and elaborate new ideas. His imitative response is notable for the sensory-motor actions which are repeated until they are internalized. Thus imitation is the bridging of the gap between the perceived unknown and the cognized known, because now the child uses a deliberate action to represent new knowledge. However, before he achieves cognitive control, further modes of behavior must expand his use of the new knowledge.

Exploration

The second mode of behavior results from an innate sense of curiosity which leads the child towards new discoveries. This is exploration. Although acknowledged by writers as preceding play (Hutt, 1971; Piaget, 1962), the position taken in this study is that of a playful mode of behavior. A step further cognitively than imitating what is perceived, exploration is a further way the child gathers sensory data about himself, objects and the people in his world, and discovers the functional characteristics of objects. During his explorations, he learns that he can cause some events to happen and that the existence of objects is constant. A great number of referents are incorporated into the child's schema during this mode of behavior, ready to be transferred to new situations in play or problem solving. Hutt (1971) noted that once the child's curiosity is satisfied, he ceases to explore and incorporates the explored objects into play situations.

Testing

In the testing mode of behavior, the child integrates new knowledge with familiar experience, then subjects the explored objects to testing. To do this requires the child to anticipate a path of action and then to try it out. If his hypothesis fails, he is faced with a problem as to successive action. Because his whole body is absorbed in the play, the probability exists that he will find a solution rather than abandon his testing. Failure may not daunt him because the environment is reacting against his imposed actions upon it, not against his person. Success in solving a problem comes from an alternate hypothesis being formed and alternative action taken. Therefore, in instructional play settings, before the child can actually formulate and test hypotheses, he needs time to become familiar with the play situation and as Dienes (1963) noted, to "fiddle around", explore the properties of his setting. The testing mode of behavior acts upon knowledge gained from the prior experience of imitation and exploration.

Construction

The most advanced cognitive mode of behavior in play is construction, where the child creates and recreates his own experience in a coherent orderly fashion within a setting he constructs himself. Sutton-Smith (1972) commented that the external world is replaced by "another set" where the child can control his actions. Imagination is allowed full rein. In construction, the child patterns and organizes previously random natured representations (Gross, 1974) and establishes relationships between things and people through the play setting. In mastering the setting, the process of construction actively furthers the differentiation process towards objective thinking and cognitive control. In construction, all other modes of behavior are integrated.

Stages of Play in Preschool Children

Play is recognized as having cognitive stages which are universally accepted by writers. Perhaps the most extensive analysis of these play stages has been described by Piaget (1962), who identified three stages of play corresponding to three stages of developing intelligence, sensory-motor, representational and reflective. These stages are practice games, occurring during the first two years, symbolic games which appear during the second year and last until approximately seven years, and games with rules, which appear about seven and continue throughout life.

In the relationship of play to intelligence, Piaget regarded play at the sensory-motor stage of intelligence as more assimilative than accommodative in nature, which means that new information received in play of this kind might not be accommodated to the child's already existing schema. Only when he deliberately tested out his actions with new objects in constructed representations, might new information be adapted to his cognitive structure. As the child progressed through the play stages, Piaget noted that his assimilative actions in play were more and more adapted to reality and formed the child's mode of thought.

In this study, the two stages identified by Piaget which occur during the early childhood years, have been broken into two further substages, recognized by other writers (Smilansky, 1968; Sutton-Smith, 1971; Therrien, 1977). Their characteristics are as follows:

Practice Play

Sensory-motor play

The child explores the objects and people in his world, using all his senses. His behavior is characterized by repetition and actions in which he explores what the object will do.

Manipulative play

Further sensory properties are discovered as the child explores what he can do with the objects. He starts to test things out in his play and invent new combinations of objects as in building blocks, or throwing and rolling balls.

Symbolic Play

Representational or role play

During the second year of his life, the child starts to substitute one object for another in his play or begins to represent himself as another person. Imagination becomes important as he indulges in play which is "just pretend."

Dramatic or thematic play

Representational play grows in complexity within both content and symbolism. The child will construct whole scenes and events, unified by a continuing theme which may constantly change as new ideas are combined with old ones.

During the Practice Play stage, the imitation, exploration and testing modes of behavior commonly occur and grow more complex as the child develops. At the Symbolic Play stage, these modes of behavior are incorporated into the construction mode which elaborates events, roles and themes.

Piaget (1962) noted that from four to seven, imaginative symbolic play in which the child's ego is expanded, started to decline and became more adapted to reality as the child's expanding social world satisfied emotional needs. Three new characteristics prevailed in later symbolic play, an orderliness in construction, an exact imitation of reality and collective symbolism where roles were constantly differentiated and adjusted. Games, still containing symbolic sequences, grew towards intelligent adaptation as in solving problems.

In the growth of cognitive abilities which have a direct bearing on the child's problem solving abilities, Piaget's theory has important implications for this study. Children who have experienced more symbolic play may have had more opportunity to develop socially and emotionally and may see reality more objectively. Secondly, in symbolic play, construction is the primary mode of behavior. The child is putting all his information together in a variety of ways. His growing schema propel him to higher cognitive levels where he may successfully attempt cognitive processes such as problem solving. Apparently symbolic play is one way the child gains the basic concrete thinking upon which later symbolic thought is built.

One of the purposes of this study was to test this theory by examining the characteristics of the play behavior of children who exhibit successful problem solving.

The Relationship of Play to Problem Solving

Four definite relationships between play and problem solving ability form the conceptual framework of this study.

Firstly, the child who views problem solving as a process rather than an end product is able to identify courses of action, often of an individual nature, in solving problems varying in scope and complexity. Play is advanced as the child's ideal process learning medium.

Secondly, the right course of action to take in any problem is a difficult decision for children to make. A correct decision for a problem results from a store of experience. In this study, a possible double advantage of play is seen in an increase of the child's knowledge structure in activity, and a greater opportunity to practise combinations of responses in a multipurpose setting.

Thirdly, play is a stepping stone in the growth of abstract thinking as well as the ability to deal with increasing abstraction within the problem solving situation.

The fourth relationship of play to problem solving lies in the specific nature of the play setting. In order to select a correct path of action, the child is required to view the problem in an objective manner. Perhaps the tendency of children to indulge freely in imagination by adopting an "as if" attitude in their play, directly enables them to literally take another point of view. As a result, the child is able to dispense for a while with his personal feelings and make a more objective decision than he might outside of the play setting.

Research indicates that the play which is specifically related to problem solving is symbolic, that is, play where the child transforms an object or himself to represent another object or person. An essential component of this type of play is representation through make-believe, which at a more advanced level, often includes construction of a theme or unifying idea. In this study, the growth of problem solving is seen as directly associated with symbolic play.

Play as a Medium for Problem Solving

Bingham (1958) wrote about problem solving,

> Children must feel free to test their abilities, to explore, experiment and explain their ideas. They need to feel comfortable in failing, then reassessing, reinterpreting and trying again.
> (p. 10).

An examination of the features of such a problem solving environment reveals many similarities to a self-selected play situation. These qualities include a variety of experiences which give the child opportunity for testing, self-discovery, planning, creating new experience as well as representing familiar experience, and above all, tolerance for the expression of feelings and opportunity to experience failure without guilt. In such a problem solving milieu, the child can try out responses through the four modes of playful behavior.

Play is a multipurpose medium where the child experiences and relives reality with all its conflicts or problems. Because problem solving is also a multipurpose activity, ample problem solving opportunities exist in the play. Of prime importance in their relationship, is that play "acts as an energizer and organizer of cognitive learning...." (Arnaud, 1974, p. 5). Pleasurable enjoyment in play motivates the child towards action, and because he formulates his own goals, he is more likely to find ways to solve problems which occur.

No one method can satisfactorily be taught to advance problem solving skills, because problems vary in their "scope, sublety, complexity and duration" as well as in nature. Bingham (1958, p. 10) howevever, saw three essential characteristics in most problems.

1. The individual has a goal more or less clearly in mind.
2. The individual's path to the goal is blocked in some way.
3. The individual feels an inward tension which spurs him toward attainment of the goal.

Achieving a solution she considered, involved every part of the child, "needs and purposes, values, beliefs, skills, habits and attitudes" in order to combine "reflective thinking and synchronization of the intellect, emotion, will and action." (Bingham, 1958, p. 10). Thus, the preschool child who in play is using every sense, his affect, his intellect, and physical attributes, is operating in optimum learning conditions for problem solving. Optimum cognitive growth is possible then in the play environment.

Although problem solving results in a final product, the solution, the ability to solve problems is a complex integration of many cognitive processes. Available to the child in play are "observing, comparing, classifying, ordering, interpreting, summarizing, and imagining," (Moffitt, 1974, p. 45), all of which are practised within the four behavioral modes evident in play. However, various forces, attitudes, past experience and perception affect an individual's skill in using these processes. One might speculate that the more play experience available to the child, the less disturbing feelings are unresolved, and the more concentration is available for cognitive learning. Consequently the child gains more problem solving experience from which to develop complex and abstract concepts.

If the play environment is an ideal learning medium for problem solving, educators may be able to direct the energy which is released through play towards the development of specific cognitive skills and concepts. Educators have strongly urged that problem solving using concrete real-life situations is an important activity in developing basic concepts for later symbolic subjects such as mathematics or language (Almy, 1967; Dienes, 1964; Nelson & Sawada, 1975; Suchman, 1964). Such real-life situations are possible in play where a distinction may be made between two forms of play environments which may be used. The first is child-initiated, stemming from personal imaginative interests, and the second is a "prepared learning environment" where the action, though prescribed by an adult, is always initiated by the child (Almy, 1967). A matching of child abilities and a challenge in the environment, motivate the child to play. For educators, a deliberate structuring of the play medium may allow greater facility for problem solving intervention. Therefore, in this study, the play environment will consist of a structured simulation of two real-life situations.

Research

Research relating play and problem solving is meager, and all studies have been concerned with an instructional play setting.

Hartshorn and Brantley (1973), over an eleven week period, conducted a dramatic play program with second and third grade students, using problem solving skills. During that period, children dramatized social studies incidents and incorporated these into other subject areas. The writers noted improved problem solving skills among the subjects who also manifested more willingness to accept responsibility for their decisions than the control subjects.

Rosen (1974) also noted improvements in problem solving among groups of disadvantaged kindergarten subjects after a 40 day dramatic play program involving role-taking skills. Of particular note was the increased productivity within the group. Perhaps in play, increased activity was related to more effective problem solving.

Using a specific problem test, Hickey (1972) examined the relationship of different play experience on problem solving ability of sixth grade children. Free play helped children achieve a faster solution than directed play of a selected design, play observation or no play. Directed play in Hickey's study appeared to be direct instruction rather than augmented play as in this study.

Sylva, Bruner and Genova (1976) studied the effect of three prior experiences on the solving of a mechanical problem. Free play proved as effective as the observe principle group in solving the problem, and both groups were significantly superior to the no treatment group. However, significant differences were noticed by the writers in the process used in problem solving. In approaching the task, the play group were more eager to begin, showed more concentration during the problem solving and proceeded more often along a simple to complex continuum than the observe principle group, which included more immediate solvers. In addition, a greater number of subjects in the play group were classified as learners during the problem solving by virtue of growth from a lower to higher judged method of solving the problem. With continued play experience, children in the play group may have been more successful in solving more complex problems than the observe principle group. Play had, in effect, helped children to learn a process by which they might solve the problem. The advantage was that the subjects learned to solve the problem for themselves.

Divergent Thinking

The capacity to change one's mind towards considering alternative ways for action, to think divergently, is a feature of successful problem solving. Biber (1971) noted that it involved changing the organization or arrangement of things, and implies that the child has a store of alternate thought responses upon which to draw.

Play directly increases the variety of responses at the child's disposal (Dansky & Silverman, 1976; Sutton-Smith, 1971). During sensory-motor manipulation and exploration of objects, children discover numerous properties of those objects which they internalize through their action with them. Their schema is enlarged to include these new responses. Later, as the child constructs more complex play themes, he tries out the objects with combinations of other objects and within situations, increasing his associational responses related to the objects. His imagination also uses the prior knowledge and postulates new responses. Thus, when faced with problems in play or elsewhere, the child has internalized a divergent number of responses from which he may draw.

Dissonance in the pathway of a goal is at the core of a problem. With fear of failure no longer a distraction in the play setting, the child will possibly consider another pathway, thus changing the relationship to his already formed view of the world (Ellis, 1972). In the preschool child, a changed direction does not just result from his ability to retrieve the right thought response from his schema. He does not achieve divergency by just thinking. A new alternative action path is suggested by his sensory-motor manipulations during the play. He determinedly continues acting along a blocked pathway until it becomes apparent that this will not work. Then, something in his actions as they fumble in play, elicits an impression from his schema and directs his thinking towards another response. His thought springs from his actions (Almy, 1967; Sutton-Smith, 1972).

In problems requiring specific answers, a solution is obtained, not through divergent thinking, but convergent thinking. However, convergent thinking requires one to selectively choose a solution from a variety of possibilities, that is, to have a fluency of responses available to him. Because fluency of response is related in parallel fashion to fluency in language response, we may draw upon the research which indicates that children achieve a fluency in language before any control is evident, and apply it to play responses (Vygotsky, 1962). For the child to think and act convergently in play, he must first have begun to think and act divergently. In this study, children who are able to think convergently and achieve a specific solution, may be children who have achieved a greater number of uses of objects within their play.

Research

Sutton-Smith (1971) hypothesized that the child with a large repertoire of responses towards things, would have more responses which could be combined with new play situations and increase the number of combinatorial responses possible. He found that children were able to produce far more responses for those toys with which they had played more, than for toys which in play, they had used less. He postulated that these children were far more likely to make an adaptive use of the play responses when the situation demanded.

Dansky and Silverman (1976) investigated Sutton-Smith's assumption with 90 nursery school children, dividing them randomly into three groups. One group played with a set of objects for ten minutes, a second group imitated the behavior of the experimenter in four tasks and a control group undertook a neutral experience, coloring. Using the four experimental objects, children were tested on an alternate-uses test. In all four tasks, the play group gave a significantly greater number of non-standard responses. These responses were of a more imaginative nature, yet descriptive of the physical properties of the objects.

To answer the question of why the play group produced more imaginative responses, one must focus on the actions of the subjects. Whereas the children in the play group concentrated a unity of energy and attention upon their actions, the imitation group was required to focus on the imitated sequence. Neither the motive to act, nor the direction taken, was decided by them. A difference lay also in the processing of the information gained during the experiment. Both groups assimilated the information from activity, but the play group moreover, was self-regulating that information to fit existing body schema. Now the combination of old and new knowledge increased the responses. Apparently, the child who is given the freedom to play will come to know about his world to a greater degree.

Divergent thinking and originality are indicators of creativity (Lieberman, 1965), but does creativity bear a direct relationship to problem solving ability? Research by Torrance and Fortson (1968) and Torrance (1972) suggested that preschool programs fostering a creative environment with an emphasis on problem solving and the development of fluency of ideas, are superior to more traditional programs in the growth of creative skills and question asking skills, but the writers fail to describe the creative environment.

Could a planned play program foster skills related to creativity? Feitelson and Ross (1973) conducted a ten week play program using deliberate adult intervention to increase the thematic content of children's play, then tested the growth of their subjects in conventional creativity tests. They noted that where children used more thematic play, there was improved inventiveness and less dependence on the provided toys. Specific improvement was shown also in measures of exploration, innovation and originality.

Deliberate intervention in children's play may increase both the symbolic content and divergent thinking. In this study then, the advantage of play with teacher intervention will be tested as well as free play.

Abstract Thinking

In preschool children's play, Stone and Church (1957) found a trend towards sustained planning of activity in play as the child showed an increasing independence from the perceptual stimuli within the play environment and actions in play became separated from their concrete content. This natural growth towards abstraction of thought in children's play can be used to advance more complex problem solving of an abstract nature.

While action in play serves to aid the abstraction process of thought, it cannot entirely be separated from language and its role in the abstraction process. Vygotsky (1962) wrote

> The process of cognitive development is at least partly a process of learning a language. Each language makes its unique distinctions and organizations of reality. Hence language both records and channels modes of thinking. (p. 177).

To the Soviet psychologists, El'Konin (1971) and Vygotsky (1966), symbolic play was the vital link in the abstraction of meaning or thought. In play "the child operates with meanings that are divorced from things, and their activities, but operates with them in relation to some real activity and some other real thing." (El'Konin, 1971, p. 230). The explicit emergence of abstract thinking in play has been explained by Vygotsky (1966). The initial fusion of word and object is lessened and he begins to focus on the meaning rather than the object. Soon he begins to act independently of the object, through the use of a representational object. However, the representational object is not yet a symbol, for its choice is based on its physical resemblance to the object it represents. What it has become is a "pivot", where the meaning of the original object has undergone a separation from the object itself. Full symbolism exists when the child chooses any object to fulfill the function of the first object. In the same manner, action and meaning undergo separation until the child uses a gesture as a demonstration of the action of an object. In Vygotsky's view then, symbolic play is the link between concrete and abstract thought.

The problems used in this study are to be solved using concrete materials, but require children to understand certain abstract concepts. It is hypothesized that children who indulge in symbolic play will experience no difficulty in coping with these abstract concepts.

Research

Little research has been done to show how play affects thought abstraction. Several studies however, indicate that increased symbolic play correlates with an increased language growth. Lovinger (1974) conducted a twenty five week intervention program of one hour daily in dramatic play with disadvantaged children. Increased flexibility in the play of these children also produced an increase in language use and ability on cognitive measures. Smilansky (1968) noted also the increased language ability of disadvantaged children after a lengthy dramatic play intervention program.

Luria and Yudovich (1971) reported in their twins study that increased differentiation within play coincided with increased differentiation within language. Support seems clear for the play medium as a developmental ground for abstract thinking needed in successful problem solving.

The "As If" Role of Imagination

As the child grows in his ability to select a suitable course of action and solve problems, he becomes more adept at differentiating himself from situational constraints. In the view of Sutton-Smith (1971), this results from the deliberate adoption of an "as if" attitude towards play objects and events, and is related to the ability to adopt representational categories at a higher conceptual level.

In symbolic play, the child imagines things about objects and then tests them out by constructing situations to represent those things. As the onlooker, he is better able to decenter himself and see a point of view other than his own. Further, the "as if" adoption also occurs in role play where the child takes on the identity of another person. He literally steps outside of himself and becomes another person in imagination.

By adopting a role, the child also adopts the rules inherent in the role, so that he is constrained to act in a certain way (El'Konin, 1971; Vygotsky, 1966). As a result, he is able to selectively ignore certain things in play because he withdraws from his own personal feelings. The factor which enables him to conserve the "as if" attitude in play may be the same factor which eventually enables him to conserve class identities, because he is able to separate himself from the immediate environment to consider things as they really are (Sutton-Smith, 1971). Perhaps he is thus one further step along the differentiation process towards abstract thinking.

In imagining a setting or role, the child must draw from his experience, anticipate a likely course of action on the basis of this knowledge and then plan and construct the components. Adoption of an "as if" role therefore, is related to the use of divergent thinking and an alternative responses repertoire. Symbolic play, using the "as if" attitude of imagination may multiply the diversity and complexity of responses gained through manipulative play.

Research

In disadvantaged Israeli children's play, Smilansky (1968) reported play behavior which was fragmented, repetitious and consisted of numbers of unrelated experiences. In a deliberate intervention program, children were encouraged to adopt more roles and develop a continuing theme within their play. The results indicated an increase in the type of play which could be called dramatic or symbolic, more role taking and more fluent language responses. Rosen (1974) also reported greater role taking ability among subjects in her study. An increase in role taking is related to an ability to adopt an "as if" attitude in play. It is postulated that this will result in the greater ability of children to solve problems.

The indication that symbolic play is instrumental in problem solving ability, has led to the question of whether symbolic or dramatic play is a developmental stage. Research by Smilansky (1968) indicated that dramatic play, especially of a social nature, did not occur among disadvantaged Israeli children as a developmental stage, a finding refuted by Eifermann (1971) whose observations indicated that disadvantaged children do indulge in symbolic play, but at a later age than privileged children.

In view of Eifermann's evidence, Sutton-Smith (1971) wrote

> This raises the question whether there may be some critical interdependencies between the time at which imaginative activity is most abundant and its availability for the development of abstract processes (p. 219).

Further, he suggested that the emergence of symbolic play at a later age may predominate at a time when the child needs freedom from his imagination to concentrate on higher creative responses required in school, as in arithmetic or reading. He conjectured that those children who have resolved the "as if" role earlier, would now be free to apply their imaginative capacities to more abstract contexts. A strong argument exists then, for the inclusion of symbolic play within preschool environments.

Summary

A summary of the main points drawn from the literature related to this study, and on which is based the conceptual framework, can be stated in the following point form.

1. The young child represents his experience in his play and his play behavior may reveal evidence of how he thinks.
2. In play are conditions which facilitate cognitive growth in the preschool child.
3. Four cognitive modes of behavior by which the child comes to know his world may be identified within play. These are imitation, exploration, testing and construction.
4. Research indicates that the type of play most often related to the growth of processes occurring in problem solving is symbolic play.
5. One may conceptualize four definite relationships between this type of play and problem solving ability.
    (a) Play is the ideal educational environment in which to develop problem solving ability because the features of the ideal problem solving environment are those of the ideal play environment.

(b) Play enables children to build a store of responses upon which to draw in cognitive activities, such as problem solving.

(c) Play leads to the development of abstract thinking which is needed in problem solving.

(d) The ability of children to adopt an "as if" stance in imaginative play, enables them to see another point of view in problem solving.

Research Hypotheses

The purpose of the study was to examine the effect of prior play experience upon the ability of kindergarten children in problem solving.

In presenting the hypotheses of this study, the general research hypotheses, based on the expectations arising from the literature are stated first. Following each research hypothesis is a specific experimental hypothesis stated in conventional null form. The final statements are some further questions arising from the theory and research base which might be asked.

Research Hypothesis

Prior play experience increases children's ability to solve problems requiring a specific answer.

Experimental Hypothesis

Ho_1: There is no significant difference among the three experimental groups on solving each of the test problems.

Research Hypothesis

Prior play experience will result in a reduction of the time taken by the subjects to solve the test problems.

Experimental Hypothesis

Ho_2: There is no significant difference in the times taken by each of the three experimental groups in solving the test problems.

Research Hypothesis

Since the test problems can be solved using the same process, division, and are considered to be equal in the level of difficulty, a high correlation should exist between subjects' scores on each of the test problems. In addition, a high correlation is expected between the times taken in solving each of the pairs of test problems which require the use of the same skill. A third correlation may be expected between subjects' scores and the times they take to solve the problems.

Experimental Hypotheses

Ho_3: There are no significant correlations between scores on any two division problems.

Ho_4: There are no significant correlations between the times taken to solve any two of the division problems.

Ho_5: There are no significant correlations between subjects' scores on each of the four test problems and the time they take to solve them.

Research Hypothesis

The research literature provides a basis for suspecting that subjects' ability to solve problems is directly related to differences in the school programs. In addition, differences between the time of day of each kindergarten class and the order of completing each pair of test problems may exist.

Experimental Hypotheses

Ho_6: There is no significant difference between treatments when school is used as a blocking variable across the eight dependent variables.

Ho_7: There is no significant difference between treatments when kindergarten starting time is used as a blocking variable across the eight dependent variables.

Ho_8: There is no significant difference between treatments when order of presentation of the problems is used as a blocking variable across the eight dependent variables.

Research Questions

The theoretical and research literature provides a basis for suspecting that the level of play reached by the child is directly related to problem solving ability. The following questions may be considered also in this study.

1. Does a relationship exist between the level of play

exhibited by subjects and their ability to solve problems?

2. If such a relationship exists, what are the features of the play behavior of those who are successful solvers and those who experience least success?

CHAPTER III

RESEARCH PROCEDURES

This chapter describes the research design selected to examine the research hypotheses stated at the end of Chapter II, then discusses the procedures used to record the data, the categories generated from the testing sessions and the statistical procedures undertaken during the analysis.

Summary of the Research Design

Two of the real-life stimulus materials designed by Nelson and Sawada (1975) were used both as play materials and as problem testing situations. These materials were Animal Groups and Cargo Groups (see Appendix A for protocols of these materials). Forty-five subjects from two schools were divided into three experimental groups, Treatment Groups I, II, and III, each of which received a different prior play experience before the testing session. For this thesis, these groups will be labelled Control Group, Free Play Group, and Augmented Play Group. Four division problems pertaining to these stimulus materials, identical to those used by Bourgeois (1976), were presented individually to each subject. The Control Group was tested on the problems during the first week of the experiment. During the second and third weeks of the study, both play groups, the Free Play Group and the

Augmented Play Group, individually participated in fifteen minutes play with the stimulus materials on each of the first three days of the week. Testing on the division problems for these two groups took place on the fourth and fifth days of the week. The researcher conducted the experiment at one school during the second week and at the other school during the third week.

In order to test the research hypotheses yet generate open-ended information about children's play, a recording method was required which could capture all the intricate details of children's play and record accurate times, while freeing the researcher to concentrate on administrative requirements. Therefore it was decided to record behaviors of the subjects during all play and testing sessions on 3/4" black and white videocassette tape. In addition, during the testing periods, the researcher recorded in writing, the procedures used by the subjects to solve the problems and the solutions obtained (see Appendix B for the recording method used). This additional measure was decided upon, firstly as another source of information should there be taping difficulties, and secondly, as a means of recording the specific animal arrangements used by subjects for the Animal Groups problems and the color arrangements for the Cargo Groups problems.

The Pilot Study

A pilot study was carried out with several children at a private kindergarten prior to the study in order to refine the following experimental measures.

1. The adequacy of the original time allowance of ten minutes for the play sessions.

2. The time requirements for the testing sessions.

3. The room arrangement for the materials and the videotape apparatus.

4. Videotape procedures, such as lighting, voice production, and difficulties the researcher might experience in operating the complete research single-handed.

5. The procedure for the suggestions for the Augmented Play Group.

6. The response of the subjects to the testing situation.

7. The feasibility of individual play sessions.

The kindergarten program of this school was self-selective, with many opportunities for play. Children indulged in much dramatic play, especially of a social nature, with their playmates. It became apparent that, for these children, individual play sessions produced abnormal responses which disappeared when two children were permitted to play with the materials. Clearly, individual play sessions would not be satisfactory for children used to sociodramatic play. However, it was hypothesized that children within a public school system would exhibit less play experience and less social interaction than children whose parents had specifically chosen the private program in preference to the public one. Before changing procedures, a second pilot study should be conducted with public school subjects.

The presence of the videotape equipment in the room did not appear to disturb the subjects unnecessarily but several other measures were refined and tested in a further pilot study.

The second pilot study used children of similar background to the experimental subjects. Five first grade children were selected from one of the test schools. First grade children were chosen because they had experienced no school contact with the kindergarten class and operated within different school hours. In this second study, a larger room was available and play materials were placed on the floor on a large mat. Both child and researcher wore a microphone with a five foot long trailing cord around the neck. These new measures proved satisfactory and were adopted in the study.

The Sample

Subjects in the sample were 45 children from four kindergarten classes, both the morning and afternoon classes from two schools in the Edmonton Public Schools System. Ages of the subjects ranged from 5.2 years to 6.6 years with a mean age of 5.28 years for School 1 and 5.58 years for School 2. Because children were to be videotaped, parents were invited to consent to their child's inclusion in the research project. Affirmative responses from each of the four classes numbered 15, 18 (one of whom was excluded from the random selection because of behavior problems), 19 and 17. In order to select 15 children for each group from the four classes, a random sample of 12 children was taken from each of three of the classes and randomly assigned to the three treatment groups. From the fourth class, an afternoon class, a random sample of 9 children was selected and randomly assigned to the three treatment groups. Thus in three of the four kindergarten classes, four children were assigned to each of the three groups, and in the fourth, three children were assigned to each of the three groups.

The Setting

Each piece of apparatus was placed on the floor on a large mat, diagonally facing inwards to the camera, but at opposing angles to each other. The stimulus materials were placed so that children had ease of movement from one game to the other at the sides and at the far end from the camera.

Both play and testing sessions were conducted in the infirmary at the first school and in one shelter room at the second school. One play session at the second school was conducted in the infirmary because a school activity took place in the shelter room.

A Sony 3/4" videocassette tape recorder and a Sony video camera were used to record the behaviors of the subjects. The camera was placed so that the outer corners of the stimulus materials and the camera formed the three vertices of an imaginary triangle. In order to achieve maximum voice production, each subject and the researcher wore a microphone with a five foot long trailing cord around the neck. Voice production proved to be at a high level with very few of the subjects' words being inaudible. The management of the cord was easily achieved by the subjects and did not appear to distract them in their activity.

Preparation of the Subjects

During the week prior to the start of the experiment, the researcher spent a total of two hours in each kindergarten class over two days. During this time, she interacted with children during their normal routine, familiarizing herself with names and engaging in conversation with children concerning their activities. Children were informed by their teachers that some of them would be chosen to play with the researcher and her special toys during the following weeks. Apart from this, teachers did not discuss the experiment with the children during the study.

The Play Sessions

During each kindergarten session, the four children in the Free Play Group came to the playroom individually for approximately 15 minutes each, followed by the four children in the Augmented Play Group.

On the first day, the children were shown the videotape and the researcher explained the camera's function and the materials. The subjects were told, "You may play with these games and do whatever you like with them." Children were requested to wear a microphone around the neck as did the researcher, and each subject was requested to move from one game to the other away from the camera so he or she would not block the camera's view of the game.

At the end of each play session, each child was asked to help pack up the play materials ready for the next child. This became an automatic activity after the first play session.

Intervention in the Augmented Play Group

During the Augmented Play Group sessions, the researcher was guided by the activity chosen by the subject in augmenting the play. If a child was uncertain and did not willingly take an active role in the play, the researcher knelt on the floor and suggested some activity which might commence the play. Where children were active in initiating play, the researcher sat at the side. Intervention used included adding suggestions, asking questions or joining in the play. Generally the researcher encouraged the development of a theme within the play, and included, where possible, conceptual task suggestions such as classification, ordering and counting.

When small problems occurred during the play, the researcher questioned children as to how they would solve them and encouraged divergency of thought by offering alternative suggestions. At all times, suggestions were offered in such a way as to leave the decisions to the subject.

The Testing Sessions

During the testing session, the two stimulus materials were set up on one large low table and the camera directed towards the apparatus in use at that particular time.

From the pilot study, it was ascertained that each child might require more than the 15 minutes allowed for the play sessions, so testing sessions occupied two days of the week. During the first week, the Control Group from the first school was tested on one day and the Control Group from the second school tested on the following day.

Half of the subjects in the play groups were tested on each of the two testing days, one Free Play subject, followed by one Augmented Play subject, both being presented with the problems in the same order. The problem order was reversed for the second pair of subjects. The remaining subjects in each class were tested on the following day.

In introducing the problem, the researcher made sure that each subject was listening and not playing with the materials. Once a problem was completed, the child was asked to help set up the materials for the next problem.

The Stimulus Materials

Animal Groups

The apparatus consisted of (i) a base board, (ii) posts, (iii) walls and (iv) animals.

The baseboard, of 2cm plywood, had dimensions 76 cm x 107 cm. Twenty-five holes formed a square array with centers 18 cm apart and were situated symmetrically on the board. The board was painted dark green.

Each post had four slots placed symmetrically around the circumference and the diameter was reduced at one end to fit the holes of the baseboard. The walls were made of 16.5 cm x 7.5 cm x 6mm masonite slabs which could easily slide into the post slots. Twenty plastic and rubber toy animals (3.8 cm to 5 cm tall) completed the apparatus.

The Problems

The set of 20 toy animals was presented to the child and he/she was asked to build enough cages so that there would be five animals in each. After the task was completed, some cages were dismantled, or some were built, so that there were three, and two of the animals were removed. The child was now asked how many animals would be in each cage if there were the same number in each (see Appendix A for detailed protocols).

Cargo Groups

The apparatus consisted of a masonite base 76 cm x 106 cm x 6 mm. At the end of the board 4 mm masonite sections, approximately 76 cm x 40 cm, were glued, leaving a winding strip (the river), approximately 35 cm wide, across the middle of the board.

Two kidney shaped islands in the middle of the river were made from 3 mm masonite, glued to the baseboard. The river area was painted light blue and the islands were green. On each side of the river a large parking lot was painted black as was a roadway leading away from each parking lot. The remainder of the board was painted green.

There were two ferry boats, of 11 cm x 6.5 cm x 3 mm masonite with balsa wood sides, with one end convex and the other concave. The apparatus also consisted of 15 plastic toy cars of red, blue and yellow, 5.3 cm x 2 cm. Three wooden blocks, one blue, one red and one white, 5 cm x 5 cm x 2.5 cm, completed the apparatus.

The Problems

One ferry boat was removed for the testing session and the three wooden blocks were used to represent houses.

The cars were placed in the parking lot closest to the child and he/she was asked how many trips would be required for the ferry boat to take all the cars across to the other parking lot if the ferry took three cars at a time. After the problem had been solved to the child's satisfaction, he/she was asked how many cars would be at each house if there were the same number at each house (see Appendix A for detailed protocols).

Difficulties Experienced During the Experiment

Adequate experimental conditions were not possible to maintain at all times. Several interruptions, completely unavoidable, occurred at both schools, but the subjects appeared to take them in their stride. In effect, these interruptions were part of the normal school operation, familiar to them. Such interruptions included high noise levels outside the room during different recess hours from kindergarten, frequent messages over the intercom which could not be silenced, children and teachers opening doors into the room by mistake. Locked doors were less satisfactory because visitors kept knocking until they were opened. During interruptions, subjects waited quietly for their finish, then pursued their play or made remarks about them and continued playing.

Analysis of the Data

The researcher first viewed all the videotapes taken during the testing sessions. On one testing day at the first school, mechanical difficulties occurred, resulting in a failure of the video lead to record any picture for all but one of the subjects tested on that day. Only the sound was recorded. All other sessions were successfully videotaped. After careful viewing of a sample of these successful tapes and comparing the recorded behaviors with the written records taken during the testing sessions, it was decided to use only the written records to determine the procedure used by each subject in solving each of the four problems and the solutions given for each. The written records of the times taken to solve each problem were checked from the sound on the videotapes. All responses to each problem were described according to procedure and solution. From these, several hierarchical categories were defined which could include all of the described responses.

The manipulations and verbalizations of each subject during the play sessions were transcribed from the videotapes. These transcriptions were later used in describing the play behavior of the lowest and highest scoring subjects.

Inter-Rater Reliability of Scoring

Reliability of the response categories

Once the response categories for each problem had been developed, three independent raters, three graduate students, all experienced teachers of young children, were asked to rank a set of randomly ordered responses for each problem from lowest to highest in terms of their understanding of cognitive functioning of young children. Principles adopted were that solving the problem was a higher cognitive functioning than not solving the problem, and evidence of abstract cognitive functioning (such as anticipation, or mental working out of intermediate procedures) higher than concrete manipulations.

In scoring the disagreements, a change in the order of any pairs of items was scored as two errors, not as one. Thus the strength of the agreements may be more than indicated by the number of disagreements. Disagreements among the raters occurred mainly in Problems 3 and 4. Rater C essentially agreed with the categories but classified each pair of items I to IV of Problem 3 in reverse order to the researcher. Each of the items out of order therefore, was scored as a disagreement. Raters A and B disagreed with the researcher concerning the order of the higher items in Problem 4. Disagreements appeared to result from ambiguous wording and after discussion, the items were rephrased. Raters A and B were then asked to reorder Problem 4 categories.

Agreement between pairs of raters ranged from 81% to 98% for the ranking of categories for the four tasks. Table 1 illustrates the reliability between pairs of raters.

The average agreement of 89.5% was accepted as a satisfactory degree of consistency in ranking the categories.

Reliability of scoring the responses

Once the researcher had scored all responses according to the categories, an independent rater

Table 1

Inter-Rater Reliability of

Categorization of Responses

Raters A,B,C,D.

Between Raters	No. of Agreements	No. of Disagreements	Percentage Agreements
AB	57	5	92
AC	50	12	81
AD	58	4	94
BC	53	9	85
BD	61	1	98
CD	54	8	87
Means	55.5	6.5	89.5

rescored all responses. Agreement between the independent rater and the researcher for the subjects' responses ranged from 95.6% to 100% for the four problems. The average agreement of 97.8% indicates that the qualitative scoring was carried out with a high degree of consistency.

The Categories

Animal Groups

Measurement division

In the first of the two problems involving Animal Groups, the subjects were presented with a group of animals and materials to build cages (see Appendix A for protocol). Each was asked how many cages it would take in order to put 5 animals in each cage. The observed responses were categorized as follows:

I The subject builds any number of cages, distributes an incorrect number of animals in each and fails to solve the problem.

II The subject builds 5 cages and places 4 animals in each cage.

III The subject builds more/less than 4 cages, distributes 5 animals in 2 or 3 of the cages but fails to solve the problem.

IV The subject builds 4 cages or more, eventually distributes 5 animals in each of 4 cages, but fails to verbalize the correct solution.

V The subject builds more/less than 4 cages and after a process of trial and error, places 5 animals in each of 4 cages and solves the problem.

VI The subject builds 4 or more cages, places 5 animals in each of 4 cages and solves the problem.

VII The subject builds more/less than 4 cages, places 5 animals in 1, 2, or 3 cages, anticipates the correct solution and solves the problem.

VIII The subject builds 4 cages, recognizes there are enough, places 5 animals in each cage and solves the problem.

Categories were ranked in hierarchical order according to the judged cognitive functioning of the children. In this problem, subjects who failed to solve the problem were scored in the lower three levels of the categories and subjects who correctly solved the problem were scored in the upper five levels. The rank ordering was decided from the way subjects interacted with the stimulus materials and may not be absolute.

Where responses appeared to be qualitatively equivalent (as in a difference in the number of cages built while using a similar distribution procedure), the category was described to include this equivalence. At a glance, the process of even arrangement of animals in category II may appear to be of a higher ranking order than categories III or IV. However, children who were scored in this category were judged to be responding to perceptual sensory-motor features of the number of 4 animals in each family grouping so were placed at a lower level than subjects who built 2 or 3 cages and placed 5 animals in these cages. These subjects were judged as having focused on an abstract feature, the numbers of animals in the cages.

In categories IV to VIII, where children successfully manipulated the materials, subjects who spent time rearranging animals after unsystematically ordering them into the cages, were judged to be at a lower level than subjects who were able to place 5 animals into each cage at the first distribution. Similarly, subjects able to anticipate the solution during or before their distribution of the animals, were judged to be functioning at the highest cognitive levels of all the exhibited responses.

One category, IV, where subjects successfully manipulated the materials but failed to solve the problem verbally, included subjects who used either systematic or a trial and error process during their distribution of the animals.

It could be argued that in nonverbal problems such as these, the categories should not be developed from a failure to verbalize an answer. However, in recording the responses of the subjects, it became clear that those subjects who failed to verbalize the correct answer did so because of an inability to achieve a one-to-one response when counting. Their response was therefore regarded as a level of cognitive functioning and included in the categories.

Partitive division

In the partitive division task with the animal groups, the subjects were asked to distribute a set of 18 animals among three cages so that there would be the same number in each cage (see Appendix A for protocol). The observed responses were categorized as follows:

I The subject refuses to do the task and fails to solve the problem.

II The subject distributes an incorrect number of animals in each cage and fails to solve the problem.

III The subject uses only some of the animals, distributes an even number of animals in each cage and fails to solve the problem.

IV The subject systematically distributes the majority of the animals but then alters the method and fails to evenly distribute the remainder, thus failing to solve the problem.

V The subject places 6 animals into each of 3 cages but fails to verbalize a correct solution.

VI The subject places 6 animals into each of 3 cages after a process of trial and error and correctly solves the problem.

VII The subject distributes 6 animals into each of the 3 cages in a systematic order and solves the problem.

VIII The subject places 6 animals each time into each of the 3 cages and solves the problem.

The rank ordering of categories was judged from lowest to highest according to the observed cognitive functioning of the subjects. Each subject who correctly completed the task was scored in one of the upper four category levels. Subjects who failed to solve the problem were scored in the lower four category levels. In this problem, all raters scored 100% agreement on all category levels.

Systematic ordering was the description used when subjects logically placed the same number of animals each time, cage by cage, until all animals had been distributed. Subjects using a systematic response were judged at a higher level than subjects who used random placing because they exhibited an ability to organize. Category III contained subjects who seemed to understand how to distribute evenly but failed to understand that all the animals must be distributed. The most common arrangements of animals in this category, was to place either 3 or 5 animals in each cage or three family groups of 4 animals. In category IV, subjects who systematically began distributing the animals into each cage but changed the procedure along the way, were judged at a higher level than those in category III who could not distribute all the animals. Children who failed to complete the task successfully often stopped during the distribution procedure to straighten animals, talk to them or discuss personal topics with the researcher. In resuming the task, most failed to remember the last cage of distribution.

Cargo Groups

Measurement division

The subjects were presented with the set of cars and the measurement division task consisted of finding how many groups of three could be made with this set of cars (see Appendix A for protocol). After examining all the procedural responses of the subjects, the following categories were devised:

I The subject fails to take all the cars across the river and fails to give a correct solution.

II The subject places an incorrect number of cars on the ferry for one or more trips, is prompted, but fails to arrive at a correct solution.

III The subject places an incorrect number of cars on the ferry but makes 5 trips and gives a correct solution.

IV The subject takes 3 cars across on the ferry on each of 5 trips but fails to verbalize a correct solution.

V The subject takes 3 cars across on the ferry on each of 5 trips, counts the number of trips and solves the problem.

VI The subject takes 3 cars across on the ferry on each of 5 trips and during the process, anticipates the correct number of trips and solves the problem.

VII The subject partitions the cars into three on the first parking lot with the hand, makes no crossing at all, and solves the problem.

Disagreements within categories in this problem resulted from categories III and IV being judged by two of the raters as being qualitatively interchangeable. Both response categories contained subjects who focused on one part of the task. In category III it was possible for subjects to incorrectly manipulate the materials yet reach a correct answer. Category IV included subjects who were able to keep in mind the requirements of manipulating the task although they failed to remember to count the number of trips. In the final decision, category IV was placed at a higher level because children who could keep the process constant were more likely to successfully manipulate further tasks than subjects of category III whose incorrect manipulations might not always yield a correct solution.

Partitive division

The second problem with the Cargo Groups consisted of partitioning 15 cars among three houses. After the first task, the cars that had been taken across the river were left in the second parking lot. The subjects were now asked how many cars would be at each house if they were parked so that there would be the same number at each house. The observed procedural responses were categorized as follows:

I The subject fails to park any cars at the houses and fails to solve the problem.

II The subject parks some or all of the cars incorrectly at the houses and fails to solve the problem.

III The subject parks an even number of cars at each house but does not use all the cars, and fails to solve the problem.

IV The subject parks the cars incorrectly at each house but verbalizes the correct solution.

V The subject parks 5 cars at each house but fails verbalize the correct solution.

VI The subject parks 5 cars at each house after a process of trial and error and solves the problem.

VII The subject correctly parks 5 cars at each house in a random order and solves the problem.

VIII The subject parks 5 cars at each house in a systematic order and solves the problem.

Subjects who successfully manipulated the problem were scored in categories V to VIII and subjects who failed to solve the problem were scored in categories I to IV.

The ability to distribute the cars evenly in this problem was judged at a higher level than the ability to distribute all the cars but fail to even them. This is a contradictory procedure in comparison with the method of categorizing similar responses in the Animal Groups partitive division task. In reviewing the procedures employed by the subjects, it was noted that those who did distribute all the cars but failed to solve the problem, used no systematic method of distribution, the criteria for subjects who were placed in a higher category in the Animal Groups problem. Therefore category III in this task was placed at a higher level.

Category IV was very difficult to rank because of the subjects giving a correct solution. These responses were reviewed and then assessed as illogical guesses, in no way being related to the manipulation of the task by the subject.

In category V, the method of correct manipulation involved either a trial and error process or a correct first placement of cars. As in the Animal Groups partitive division task, failure to verbalize an answer was related to an inability to achieve one-to-one correspondence when counting.

For those subjects who achieved the solution, responses were ranked according to the method used during partitioning. Indication of organization in parking methods was judged at a higher level than those of random parking order.

Statistical Analysis

To assess any consistency among the the responses, the eight dependent variables were subjected to a Pearson Product Moment Correlation.

All scores were subjected to a one-way analysis of variance to compare the total scores of the three treatment groups. Next, scores were subjected to three two-way analyses of variance in which three factors, school, AM/PM kindergarten starting time and order of task were used as blocking variables. Finally the data was subjected to a 2 x 2 x 3 three-way analysis of variance to analyze the impact of school, AM/PM, and treatment upon the eight scores.

The results of the statistical analysis are reported in Chapter IV.

Summary

In Chapter III the procedures for administration of the study have been discussed followed by a description of the methods used to develop the response categories and how they were scored. Consistency was demonstrated in an acceptable percentage of inter-rater reliability.

Finally, a description is given of the statistical analyses employed to test the experimental hypotheses.

CHAPTER IV

ANALYSIS AND RESULTS

The prime focus of this study was the effect of prior play experience on children's problem solving. The first section of this chapter reports the analysis of the data related to the experimental hypotheses. A further section discusses the findings pertinent to the research questions outlined in Chapter II.

There were eight dependent variables, scores on each of the four test problems and the times taken to solve each of the four test problems. The independent variables were treatment, school, time of kindergarten day and order of presentation of the problems.

A one-way analysis of variance was carried out in order to assess the main effects of the treatment upon the eight dependent variables. Three two-way analyses of variance were used to test the effects of the other independent variables.

One-Way Analysis of Variance

The first two hypotheses were tested through a one-way analysis of variance.

Hypotheses: The Effect of the Treatment

Ho_1: There is no significant difference among the three experimental groups in solving each of the test problems.

Ho_2: There is no significant difference in the times taken by each of the three experimental groups in solving the test problems.

Results

The ANOVA (see Table 2) revealed no significant main effects of the treatment on any of the criterion scores. Ho_1 and Ho_2 are therefore accepted.

An examination of the mean and standard deviation of each experimental group revealed an increase in the predicted direction in favor of free play and augmented play in three of the four test problems. The increase was greater for the free play group than the augmented play group on the fourth problem. Table 3 reports the mean and standard deviation of each group.

Mean scores on both measurement division problems, Problems 1 and 3, revealed that the majority of subjects failed to solve these problems but achieved more success in the partitive division problems. A question exists as to whether the pairs of problems were of equal difficulty.

On the times taken to solve the four test problems, the mean time of the measurement division problem of Animal Groups was approximately three times longer than the mean time of the other three problems. The effect of the longer time may be noticeable in subjects' scores when order of presentation was changed. Table 3 reports the mean and standard deviation of each of the times

Table 2

One-Way Analysis of Variance on the

Eight Dependent Variables

Variable	Source	S.S.	d.f.	F	Probability
Problem 1	Treatment	14.933350	2	1.74	.187997
Scores	Error	180.26685	42		
Problem 2	Treatment	12.933350	2	2.15	.129015
Scores	Error	126.26685	42		
Problem 3	Treatment	11.910889	2	2.66	.081646
Scores	Error	94.000244	42		
Problem 4	Treatment	8.4001465	2	0.7	.495164
Scores	Error	246.80005	42		
Problem 1	Treatment	6.4001465	2	0.19	.830680
Times	Error	721.30005	42		
Problem 2	Treatment	3.8999023	2	.59	.557209
Times	Error	138.10010	42		
Problem 3	Treatment	3.8110352	2	.57	.570800
Times	Error	140.83350	42		
Problem 4	Treatment	11.210938	2	.49	.617756
Times	Error	483.20020	42		

Table 3

Means and Standard Deviations of Treatment Groups on Eight Dependent Variables

	Control		Free Play		Augmented Play	
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.
Scores on Problem 1	2.7333	1.8310	3.8000	2.0424	4.0667	2.3135
Scores on Problem 2	4.7333	2.0517	5.6667	1.5430	6.0000	1.5584
Scores on Problem 3	3.4667	1.3020	3.7333	1.6676	4.6667	1.4960
Scores on Problem 4	4.0667	2.4919	5.0667	2.4044	4.2667	2.3745
Times on Problem 1	9.0667	3.1952	9.0667	5.4703	8.2667	3.3746
Times on Problem 2	2.1000	1.2705	2.8000	2.6376	2.6000	1.1370
Times on Problem 3	3.0000	1.6366	2.4000	1.5492	3.0333	2.2318
Times on Problem 4	2.6333	1.6198	2.3667	1.4573	3.5333	5.4559

taken to solve each problem.

Further examination of the standard deviations revealed a wide variation across the times taken to solve the problems. In each case the standard deviation can be attributed to maverick scores.

Discussion

The data does not support the notion that free play or augmented play would affect problem solving ability. One possibility may be that no relationship does exist between play experience and problem solving. Perhaps ability in problem solving is dependent upon factors such as age, intelligence or home background which were not examined in this study.

However, in view of the research findings reported in Chapter II, the possibility that there is no relationship between play and problem solving appears to be unlikely. There seemed to be, moreover, some differences within this study, indicated in the mean scores of each of the test problems for the play groups. Generally these means were in the predicted direction. Rather than reject the value of the play treatment altogether, other reasons may be advanced to account for the failure to achieve a significant increase in favor of the play groups.

Sylva, Bruner and Genova (1976) reported two kinds of successful problem solvers in their study: those who observed the principle by which to solve the problem, and play subjects who progressed through one or more levels of play behavior during the solving of the problem. In this study, frequency charts (see Appendix D) revealed that some of the control group were successful at solving the problems. Perhaps children had, during their kindergarten year or previously, learned some of the principles behind the division problems posed. Maybe it was too difficult a task for play subjects to improve in problem solving to a greater extent than the control group whose success in solving the problems was already substantial.

In reference to the second finding reported by Sylva et al (1976), perhaps level of play behavior should be considered in this study. Did the subjects in this study progress to higher levels of play behavior over the three day experimental period? Secondly, was the experimental time adequate for subjects' play behavior to reach the level of symbolic play which the theoretical and research literature identifies as the medium for the development of problem solving skills?

A review of the transcriptions of subjects' play behavior seemed to indicate that subjects played at different levels during the three day period. Maybe it was the level of play rather than the treatment in this study which was predictive of problem solving ability.

There appeared to be several factors which may be related to subjects' play level and thus may have accounted for the non-significance of the ANOVA results. Perhaps age and maturity may be indicative of success in solving problems and in play level. Bourgeois (1976) noted that subjects up to 6 years of age experienced little success in solving the problems in his study. However, in this study, several subjects were able to achieve success in the same problems. Were they older subjects? More maturity may be exhibited by older subjects as a result of objective behavior within play. Several subjects during the play sessions appeared to show immature behavior concerning the play materials. Activities such as squealing, acting in the role of animals and commenting on sensory data such as colors of objects seemed to be characteristic of these subjects. A review of some of the ages showed that these subjects tended to have ages lower than the mean ages of subjects in the study.

An additional relationship to play level may be differences in the home background of subjects. Discussion with teachers of experimental subjects revealed that several subjects from School 1 could be called disadvantaged because of lack of experience common to most children, poor quality of language and lack of concentration. Hints which suggested disadvantaged play behavior appeared during play sessions. Remarks concerning personal home experiences were made by a few subjects. Such experiences seemed to the researcher to be atypical of normal children and characteristic of a disadvantaged home environment. Several children also exhibited play behavior which seemed to be largely of a sensory-motor manipulative level.

A third relationship to play level may be the type of kindergarten program experienced by subjects. During the familiarization period, it seemed that both schools operated quite different programs. In further talking with the teachers, there appeared to be differences in the way both programs were administered and in the activities offered within the classroom. The teacher in School 1 preferred a more structured teacher directed program aimed at removing deficiencies within children's concept development. Children at School 2 chose centers at which to work during their kindergarten day. These centers allowed several opportunities for socialization and play. Perhaps program differences might be related to play level.

In order to answer these questions, 12 subjects, six achieving higher level scores, and six achieving lower level scores were selected, and a closer examination undertaken of the level of play behavior during the play sessions. The results are reported in the second section of this chapter.

A second major reason for failure of children to improve significantly in problem solving ability may be that the three days in this study were inadequate for the growth of problem solving skills. Support for this possibility is found in Dienes (1960) who expressed Piaget's view that the forming of a concept takes far longer than thought. The development of the concept of symbolism will thus take a long time in children who have not achieved it. Further support is found in the research literature reporting significant growth in play behavior only over a lengthy period of several weeks (Feitelson & Ross, 1973; Lovinger, 1974; Rosen, 1974; Smilansky, 1968).

Several indications that subjects could use more time were noticed by the researcher. By the third play session, the majority of subjects appeared more interested in the play materials than during the two previous days. Among augmented play subjects particularly, there was greater movement around the play materials, faster action in play and an increase in verbalization. Further evidence was noted in the tendency of subjects to select one game only to play on the latter days. Although familiarity with the environment may have resulted in a more relaxed atmosphere where children could move more freely, perhaps as Hutt (1971) discovered, the initial curiosity in new objects had been satisfied and now after three days, with a complex play setting, subjects had only begun to play with the objects. With additional experimental time, subjects might have used the materials further to gather diverse information which could relate to problem solving ability.

Correlations Among Dependent Variables

Hypotheses: Correlation of Scores and Times

Ho_3: There are no significant correlations between scores on any two division problems.

Ho_4: There are no significant correlations between the times taken to solve any two of the division problems.

Ho_5: There are no significant correlations between subjects' scores on the four test problems and the times they take to solve them.

A correlation matrix was produced to test the above hypotheses. Table 4 reports the correlations.

Results

Scores on each of the test problems correlate significantly with scores on each of the other test problems. The correlations appear to support the notion that all the test scores are influenced somewhat by the same cognitive skill. On the basis of the information in Table 4, Ho_3 is rejected.

Scores on the Animal Groups measurement division problem are not correlated with the times taken to solve that problem and are negatively correlated with the time taken to solve the measurement problem of Cargo Groups.

Scores on both the partitive division problems are not significantly correlated with the times taken to solve them. Table 4 also reveals the correlations of the scores with their times. On the basis of this information, Ho_5 is accepted.

Table 4

Correlation Matrix: Eight

Dependent Variables

Variables	1	2	3	4	5	6	7	8
1 Scores on Problem 1 Measurement Division		.466[c]	.452[c]	.295[a]	.023	-.090	-.318[a]	.083
2 Scores on Problem 2 Partitive Division			.568[c]	.579[c]	.008	-.068	.014	.049
3 Scores on Problem 3 Measurement Division				.456[b]	.024	-.212	-.371[a]	.007
4 Scores on Problem 4 Partitive Division					.248	.063	-.024	-.170
5 Times on Problem 1						.323[a]	.281	-.055
6 Times on Problem 2							.386[b]	.012
7 Times on Problem 3								-.069
8 Times on Problem 4								

[a] $p < .05$ [b] $p < .01$ [c] $p < .001$

A positive correlation exists between the time taken to solve Problem 1 and the time taken to solve Problem 2. In addition, a significant correlation between the times taken to solve Problem 2 and Problem 3 is noted. Because some correlation exists between times taken to solve pairs of problems, Ho_4 is rejected.

Discussion

The significant correlations among scores on each of the division problems suggest that subjects' ability in one division problem relates to ability in other division problems. However, the correlations account for a fairly small amount of the common variance. An examination of the subjects' raw scores revealed that while most subjects achieved a similar level in two or more problem scores, variability in scores on one or two problems was a common finding. Bruner (1966) noted that kindergarten children are enormously erratic in their behavior on cognitive tasks and this might account for a lower than expected correlation among division scores. Perhaps with age, susceptibility to perceptual distractions would no longer be a problem, and the ability to reverse thinking to check operations, a feature of the operational period of development, might result in more consistent scoring.

A significant and negative correlation was noted between time on Problem 3 and the scores on Problems 1 and 3 (both measurement division problems). Probably in these problems, which proved most difficult to subjects, some effect of the play experience was seen in the shorter time required to solve Problem 3. Were the timing for the Animal Groups problem to exclude the proportion taken to build the cages, a significant relationship in time might have been evident in this problem as well.

The third finding was that a positive correlation existed between the times on Problems 1 and 2, and the times on Problems 2 and 3. A learning effect might be expected to produce a negative correlation in subsequent problems. Play behavior during play sessions appeared to reach its height on the third experimental day. Perhaps the manipulations by children in the problem session triggered the desire to continue playing and resulted in an increased time being spent on the following problem.

Two-Way Analysis of Variance

Three two-way analyses of variance were conducted for each of the eight dependent variables. Each analysis enabled an examination of the combined effects of treatment and one of the following independent variables, which were used as blocking variables: school (2 levels), time of kindergarten day (2 levels), and order of presentation of problems (2 levels).

Hypotheses: Independent Variables

Ho_6: There is no significant difference between treatments when school is used as a blocking variable across the eight dependent variables.

Ho_7: There is no significant difference between treatments when kindergarten starting time is used as a blocking variable across the eight dependent variables.

Ho_8: There is no significant difference between treatments when order of presentation of the problems is used as a blocking variable across the eight dependent variables.

Results

The first two-way analysis of variance tested the combined effects of the school and treatment upon the criterion scores. The ANOVA revealed no significant effects, either school or treatment on any of the scores of the test problems.

A significant interaction, school by treatment, was revealed on Problem 4, the partitive division problem of Cargo Groups. Figure 1 illustrates the interaction and the ANOVA is reported in Table 5.

On the times taken to solve each of the four problems, the ANOVA revealed a significant main effect of school on the time for Problem 2 (see Figure 2). The ANOVA is reported in Table 6.

No significant interaction of school by treatment on times taken to solve each of the four problems was revealed. Ho_6 is accepted despite the main effect on Problem 2.

A second two-way analysis of variance tested the combined effects of starting time of kindergarten and

Figure 1

Scores on Problem 4

(Effect of school by treatment)

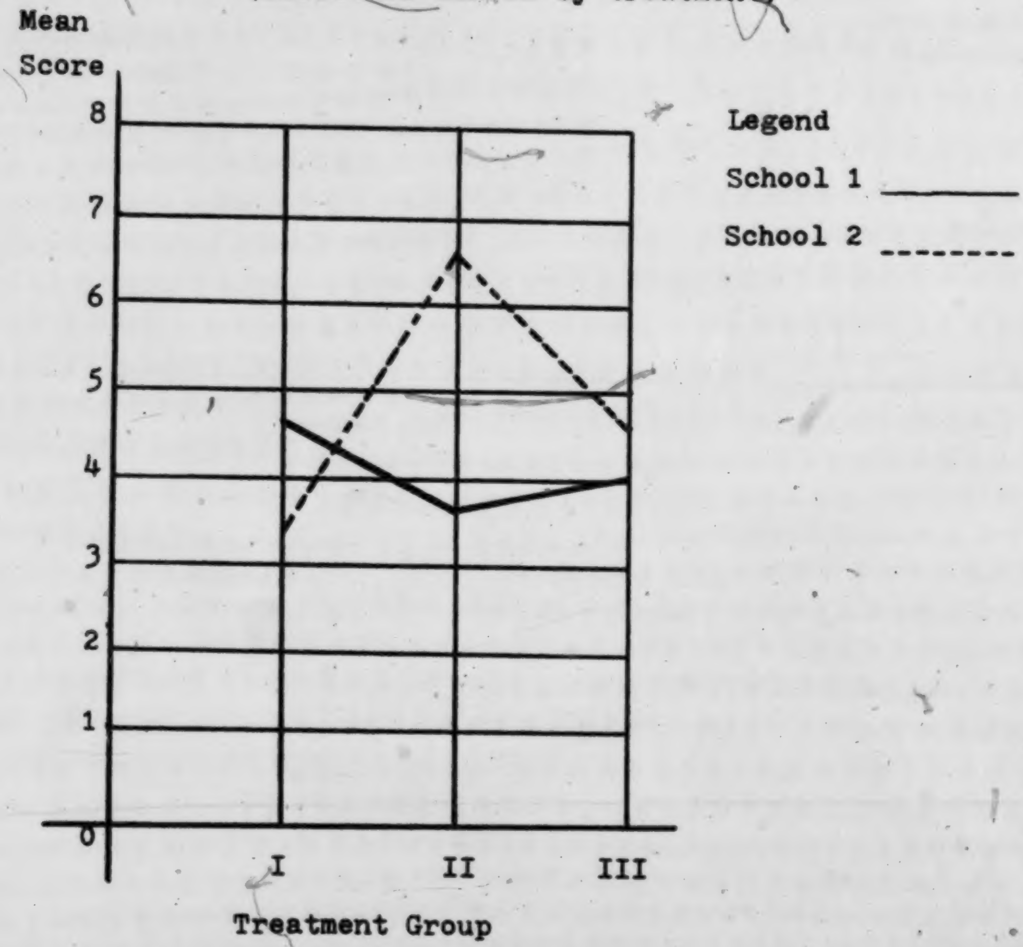

Table 5

Source	S.S.	d.f.	F-ratio	Probability
A (School)	7.55714	1	1.44045	.23731
B (Treatment)	10.7246	2	1.02210	.36928
AB	34.6357	2	3.30093	.04738*
Error	204.608	39		

* Significant at .05 level

Figure 2

Times on Problem 2

(Effect of school by treatment)

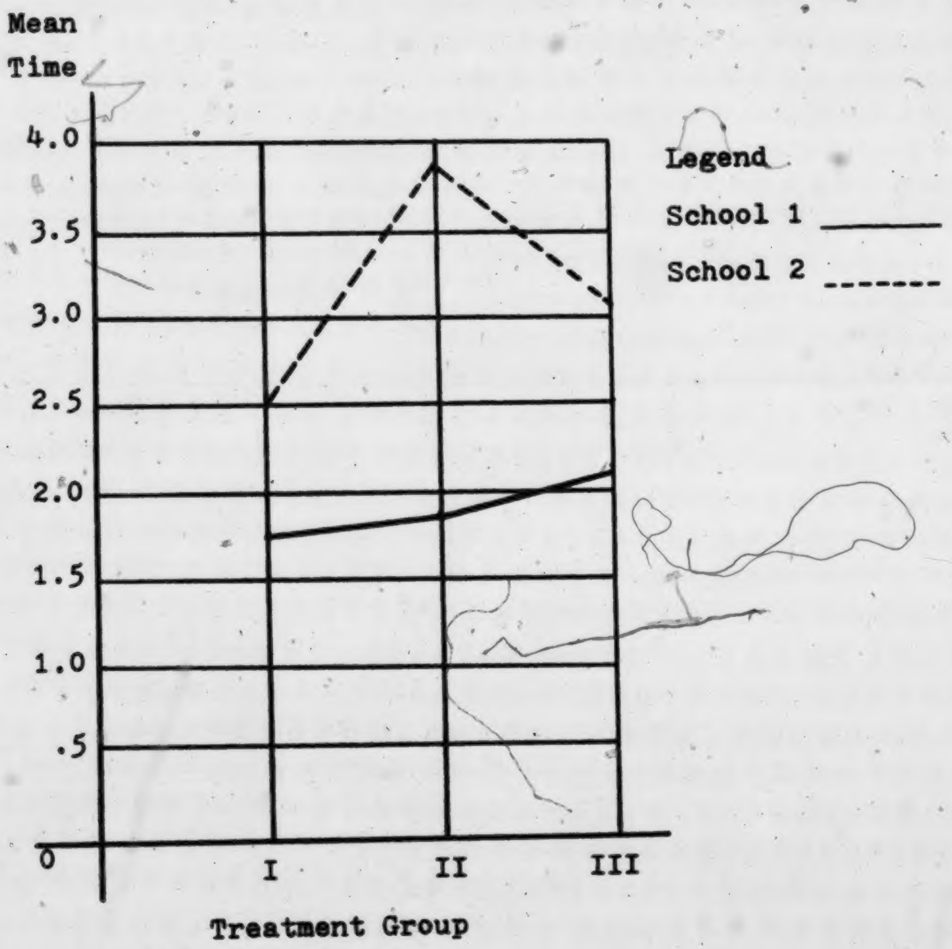

Table 6

Source	S.S.	d.f.	F-ratio	Probability
A (School)	16.2723	1	5.35925	.02596*
B (Treatment)	4.27917	2	.704667	.50046
AB	3.41250	2	.561950	.57464
Error	118.416	39		

* Significant at .05 level

treatment. The ANOVA revealed no significant main or interaction effects on any of the eight criterion measures. Ho_7 is therefore accepted.

A third two-way analysis of variance tested the combined effects of the order of presenting the problems and treatment. The ANOVA revealed no significant main effects of treatment or order.

A significant interaction of the order by treatment was revealed for scores on Problem 2. Figure 3 illustrates a disordinal interaction between order and treatment. The ANOVA is reported in Table 7. On the basis of the information, Ho_8 is accepted but with some reservations.

A three-way analysis of variance was used to test the combined effects of treatment, school and time of kindergarten day on the eight dependent variables. No further significant main effects were revealed through the three-way analysis of variance.

Discussion

The effect of school

In the discussion of the results of the one-way ANOVA, differences were noted in the play behavior of subjects at the two schools. The majority of the play subjects at School 1 appeared to play at a low level typical of the disadvantaged children described by Smilansky (1968). At School 2, a larger number of subjects appeared to use play themes. Suggestions by the researcher in augmenting the play were not always acceptable to these subjects who

Figure 3

Scores on Problem 2

(Effect of order by treatment)

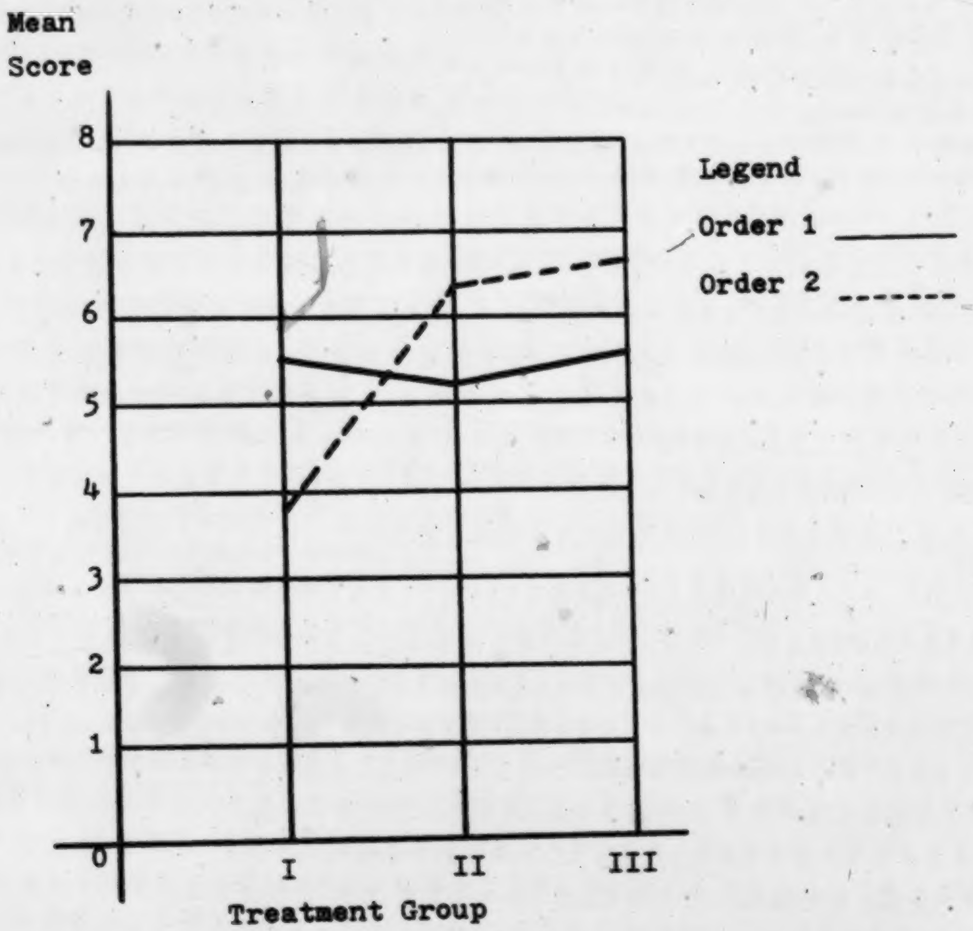

Table 7

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	.432143	1	.157693	.69345
B (Treatment)	14.9595	2	2.72943	.07773
AB	18.9595	2	3.45926	.04140*
Error	106.876	39		

* Significant at .05 level

seemed to make their own decisions. Perhaps these children had a substantial play background, especially at the symbolic level.

Among subjects with this experience, Dienes (1960) noted that with familiarity with concrete materials, play would quickly move from the manipulative play stage to the symbolic stage. However, if children have never developed an ability to play symbolically, increasing play opportunity or augmenting play is unlikely to result in a higher play level or increased cognitive growth over a short period of time (Lovinger, 1974; Rosen, 1974). While the source of differences in the schools may probably be attributed to home background, the school program may have had some effect upon the play level of subjects in School 2.

The Free Play Group at School 2 achieved a higher mean score in Problem 4 than the Augmented Play Group. Possibly in augmenting the play of these subjects, the researcher may have tried to hasten convergent thinking with some of the suggestions before children were ready.

Alternately, subjects may have had insufficient time to play with the Cargo Groups materials, so that thematic play had not run its full course before they were required to solve Problem 4. In solving that problem, subjects would be required to think convergently at a time when they had been thinking divergently.

In solving Problem 2, Augmented Play subjects took a shorter time than Free Play subjects. Perhaps the reason may lie in the nature of subjects' play with the Animal Groups materials. Whereas Augmented Play subjects were helped to discover how to build the cages and encouraged both to develop play themes using the cages and animals, and to sort and count within the play theme, Free Play subjects lacked this practice, because none discovered how to build cages where they could sort animals. Consequently, during the problem solving, Augmented Play subjects may have proved more efficient at distributing the animals and building cages.

The effect of order

The third two-way analysis of variance revealed an interaction effect of order by treatment on the scores of Problem 2 (the partitive division problem of Animal Groups). In Order 1, subjects solved the Animal Groups problems first and in Order 2, subjects solved these problems after the Cargo Groups problems.

An examination of the mean times taken to solve the previous problem, Problem 1, revealed that subjects took approximately three times the mean time required to solve the other three problems. The mean scores in Table 3 also revealed that this problem was more difficult for subjects than the other problems. The combined effects of length of time and difficulty on Problem 1 may have caused subjects who solved the problems in Order 1 to experience fatigue which may have affected their ability to solve the following problem. Such does not appear to be the case with play subjects of Order 2. Perhaps by the time they were faced with the difficulties of Problem 1, these subjects had experienced enough feelings of success to be unaffected by fatigue or failure.

A second reason may be that subjects who experienced Order 2 presentation had learned how to solve the problem by the time they were required to solve Problem 1. Success would result in less time needed to solve consequent problems.

Research Questions

Emerging from the ANOVA findings reported in the first section of this chapter were two research questions.

1. Does a relationship exist between the level of play exhibited by subjects and their ability to solve problems?
2. If such a relationship exists, what are the features of the play behavior of those who are successful solvers and those who experience least success?

In order to answer the research questions, subjects' raw scores were examined. Six subjects whose scores were mainly in the lower categories I to IV of each problem were selected, as well as six subjects whose scores were mainly in the upper categories V to VIII of each problem. Among highest scorers, some subjects achieved one score which varied considerably from the other three scores on the four test problems. Using videotape transcriptions a closer examination was made of the play behavior of these two groups of subjects. Play was described using rough categories identified from the theoretical and research literature.

Relationship of Scores to Play Behavior

Subjects Achieving Lowest Scores

Among the lowest scorers, four subjects were in the Free Play Group and two subjects were in the Augmented Play Group. Four subjects were from School 1 and two from School 2. All subjects seemed to exhibit a majority of play behavior which could be categorized as sensory-motor manipulative play. Very few instances of symbolic play seemed evident. Those observed fell in the representational level of symbolic play and consisted of fragmentary unrelated sequences such as using animals in the role of television characters, causing car accidents or playing police cars chasing offenders. Behavior modes prevalent in the play were imitation, exploration and testing. None of these subjects appeared to exhibit the combinatory behavior of construction. Augmented Play subjects seemed to be slow in initiating their play. The researcher took an active role in suggesting new ideas. Subjects seemed to respond by imitating the behavior and carrying out suggestions readily, voicing no objections.

Subjects Achieving Highest Scores

Of the six subjects with highest scores, the most consistent and successful solver seemed to use thematic play from the first day and throughout all play sessions. Four of the other five subjects appeared to use both manipulative and symbolic play of a representational nature on the first day, then develop a theme within the play on subsequent days. Of particular note seemed to be the continuation of one theme during all play sessions. A second noteworthy item was that three of these subjects appeared to integrate materials from both pieces of apparatus into the play theme.

Four of the six higher score subjects were in the Augmented Play Group and two in the Free Play Group. In addition, five subjects, one Free Play and four Augmented Play subjects were from School 2. Among Augmented Play subjects, the initiation of the play theme appeared to be undertaken by the children who seemed to use planning, cooperative and organizing activity in developing the theme with the researcher. Although suggestions concerning the play were made by the researcher, none of these subjects appeared to accept them readily. Instead, they seemed to be selective of those they used, choosing to ignore them or incorporate them in their play in an individualistic way.

Features of Play Behavior

Lowest Scoring Subjects

Modes of behavior

Imitation seemed to fill a major part of the play of both Free Play and Augmented Play subjects, appearing to be related to familiar television characters, their actions and everyday activities.

Among lower play subjects, there seemed to be a real lack of curiosity concerning the materials. The Free Play Group made initial discoveries about the physical characteristics of animals but failed to discover how they could use the building equipment, or how to make the ferry carry cars across the river. Two children discovered that the pegs fitted into the holes, but none discovered how the slats fitted. A variety of responses was displayed in using the slats, the most common being to lay them flat on the board, or to balance them in between the top of two standing pegs, either in their holes or upside down on the board, prongside up. Not one of the six subjects tried to place the slats vertically in their slots.

Three of these subjects appeared to use the testing mode of behavior to see how far they could go with the materials. Mischievous squealing, and destructive-type activities such as crashing cars and causing animals to fight, were displayed by five of the six subjects, while one of these five continually scolded the animals.

Objectivity

A common feature of the play of the lowest scoring subjects appeared to be subjectivity within their play. Behavior included responding to the perceptual features of family and color, subjective comments on the appearance of the animals, making noises relating to the play objects, calling animals by name and showing various emotional responses towards objects. The subject who achieved the lowest scores appeared to use his play as an ego builder where he became the hero.

To explain one's activity within play to another person may indicate a growth in objectivity, because to do so may require an ability to see from another's point of view. One subject seemed to show an attempt to do this by explaining to the researcher that the water was only pretend water. However, it must be noted that the water in the materials was meant to suggest water and was not symbolically represented.

Concentration

By the end of the third play session, only one of the six lower play subjects appeared to be absorbed in his play. Generally, throughout all play periods, concentration seemed spasmodic, as children punctuated play with questions about objects in their surroundings, or commented on home and everyday school experience. In addition, four out of the six subjects made swift changes between games at one or more sessions.

Problems

The problems subjects encountered in their play were noted and the responses they made. In general, lower play subjects seemed to experience no real problems as they tended to play within narrow familiar confines, avoiding problem confrontation. Only one child who attempted to build a cage but failed to discover a workable method, appeared to be willing to suffer failure. Every time his cage fell, he rebuilt, but in exactly the same manner, altering his building direction only when the researcher suggested he try another method. Two other subjects who met with problems in building a successful cage, packed up the materials at the first failure and transferred their attention to the other materials.

Diversity of responses

Responses exhibited by subjects in the lower play groups appeared to be suggestive of the nature of the materials. Thus, in the Cargo Groups apparatus, subjects drove cars, parked them, ordered them into lines, crashed them into each other and loaded them on the ferry but did not use the ferry to carry them. In the Animal Groups apparatus, animals were handled and examined, made to stand carefully, placed in families, moved according to their nature and cages of a kind were built for them. Responses seemed to be single instances of one activity which could be done with objects. It was common for children to play in some fashion with the pegs and slats then pack them away or leave them while they played with the animals. A few play sequences combined more than one of the materials within each apparatus, as in Animal Groups where subjects built some kind of cage and placed animals within it or sat them on the slats.

Highest Scoring Subjects

Modes of behavior

The most notable mode of behavior used by highest scoring subjects appeared to be construction, where subjects used imitation, exploration and testing within developed play themes which lasted for some time. The incidence of imitation within the play seemed to be far less in subjects with a higher play level than with lower play subjects. Much more curiosity also seemed to be evident concerning play materials, and much less curiosity in the surrounding environment.

The construction of a theme was continued over most of the play periods with new ideas being constantly added through revision of the ideas suggested by the researcher, or from new ideas which seemed to originate from the child monitoring his activity through his verbalizations and manipulation of the materials.

Objectivity

Subjects often gave explanations of their activity to the researcher, appearing to have some understanding of the view of the onlooker. Children, moreover, seemed to be able to stand back from their play and describe the whole scene as if it were in real life. Themes more often seemed to simulate real life themes, e.g. journeying from one place to another with identifying landmarks represented by the play materials. More imaginative behavior was evident in one subject's play. One noticeable feature of these subjects' play seemed to be the ability to comment on everyday happenings while maintaining the integrity of the play theme. They seemed to be able to conserve it.

Concentration

More planning seemed to occur in higher level play subjects than in lower level play subjects. They also seemed to be quite involved in their play and exhibited enjoyment by singing softly to themselves, playing with words, and constantly chattering about their activities.

Problems

Many problems occurred in the construction of the play themes but subjects appeared undaunted by failure. There seemed to be however, some awareness of the presence of the researcher from the individual comments. One subject laughed when his cage fell and said about the remaining peg, "At least this didn't fall down." Another subject drew attention to her failures by constantly remarking, "Now why did I do that?" and then glancing towards the researcher.

Diversity of responses

Higher scoring subjects seemed to display greater diversity in their responses in play, especially by combining ideas in their theme. Less evidence appeared in these subjects of being stuck in a rut as they seemed more able than lower scoring subjects to change their minds within their play. Suggestions from the researcher seemed to be adopted by subjects when they could think of an individualistic way to use them. Play activity appeared also to grow more diverse and complex through the subjects' verbal monitoring of information in their activity. This was seen particularly when subjects were building animal cages. Here subjects altered building methods when failure occurred, and in subsequent attempts often integrated other materials to make their cages stand.

Comparison of Ages

The comparison of the play behavior of lowest and highest scoring subjects leads the researcher to accept that a relationship existed between these children's problem solving ability and their level of play. A further comparison was made of the ages of these subjects. The mean age of subjects who achieved highest scores was six months higher than the mean age of subjects who achieved lowest scores. Perhaps age is a vital factor in problem solving ability.

Discussion

Although the findings concerning play level appear to conform to the literature which relates higher cognitive ability with subjects whose play behavior may be regarded as largely symbolic, other considerations should be discussed.

Firstly, details of intelligence, background experience or language maturity were not obtained for subjects in this study. These factors may have as much connection with problem solving ability as the level of play behavior. In addition, the evaluation of the complex interaction of all these factors is an enormous, difficult and complicated task, if one seeks to identify trends which may be related to children's problem solving ability, and this was not considered in this study. What was proposed was to note relationships between play behavior and problem solving ability.

A second consideration was that the categorization of children's responses in a hierarchical order, the basis upon which problem solving ability was judged in this study, may not have been absolute, or in evaluating children's cognitive functioning, may have been placed incorrectly in the hierarchy.

Among the few subjects whose play behavior was examined in this study, however, there appears to be a relationship between level of play, age and problem solving ability.

Relationship of play level

Features of the play of lower play subjects seem similar to those of disadvantaged children reported by Smilansky (1968). Subjects' use of play materials was largely manipulative consisting of sensory-motor exploration and isolated representations of adult activity. Verbalizations were not particularly related to play content. Higher play subjects also used the materials as their nature suggested but displayed more abstract uses within a play theme and increased verbal description which outlined the thematic content of the play.

A difference in the content of verbalizations was found also by Smilansky who noted that differences existed between low and high level play children in the quality and content of the verbalizations but not in the quantity. The increased use of verbalizations concerning play content among higher play subjects serves several purposes. It allows the child to maintain initiative in his play, a feature not noted in the lower play subjects. Further, it allows him to express ideas which are then reinforced by the experience gained from incorporating them into his play. A third advantage is the help afforded the child in creating individual activities in a desired mold. Lastly, the verbalizations keep a channel from the child's voiced thoughts to the outside cues which "boosts the construction of his own progressive action." (Smilansky, 1968, p. 28).

Effect of age

From the finding that the mean age of higher play subjects was six months higher than the mean age of lower play subjects, one might postulate that in six months' time, subjects using largely manipulative behavior may achieve symbolic play. Eifermann (1971) indicated that this occurred among disadvantaged children in her study. Perhaps children learned to play symbolically from socializing with other children who have experienced this kind of play. However, as Sutton-Smith (1971) suggested, experience of symbolic play at a later age may not yield the same cognitive advantages seen during the preoperational period of development. Maybe age is not the crucial element in the emergence of symbolic play. Perhaps children learn how to play symbolically from other models. Several writers (Smilansky, 1968; El'Konin, 1971; Feitelson & Ross, 1973) have reported research which related the growth of symbolic play to intervention by adult models of instruction who played with children over a long period of time. Possibly some subjects in this study did not experience this kind of deliberate intervention prior to or during their kindergarten year.

In this study, perhaps age is related more to problem solving success than to play level. Bourgeois (1976) noted that his subjects experienced problem solving success from 6 years of age. Further research would be needed to ascertain this possibility.

Perceptual distractions

Several of the subjects achieving higher scores had one score which varied considerably from the others. Perhaps this is evidence of the susceptibility of young children to perceptual distractions noted by Bruner (1966) and Bourgeois (1976). To achieve success in problem solving requires the child to cut through the distractions which are within every situation. In doing so, he grows intellectually (Dienes, 1963). Perhaps subjects who achieve high scores but are still erratic have begun to overcome perceptual distractions but have not yet achieved cognitive control. Thus their attention might wander during several tasks. Perhaps cognitive control will be reached during the operational period of development.

The emotional responses of lower play subjects to familiar materials and the concern with perceptual cues such as color and family groupings, seems to suggest that these subjects were so subjectively involved with things in the environment that they failed to notice objects which did not touch their affective nature.

Conclusions

1. Play experience with problem solving materials over a three day period does not appear to significantly increase problem solving ability. There is a possibility that other factors such as play level and the time allowed for play may be more predictive

of problem solving success.

2. Success in problem solving may vary according to school. The specific relationship of school to problem solving was not ascertained in the study, but may be in the effect of home background upon subjects' play level and problem solving ability or in the effect of school program.
3. Success in one division problem appears to relate somewhat to an ability to solve other division problems.
4. Among subjects in this study, there appears to be a relationship between children's problem solving success and play level. The higher the subjects' scores, the higher appears to be the play level. Problem solving ability and play level appear also to be related to age.

CHAPTER V

CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The purpose of this study was to examine the effect of three prior play experiences on the ability of kindergarten children to solve four division problems. Forty-five subjects were randomly selected from four kindergarten classes in two schools and randomly assigned to one of three treatment groups, No Play, Free Play and Augmented Play. Subjects in the two play groups individually played with the two problem solving materials, Animal Groups and Cargo Groups, for 15 minutes on each of three days. Testing for the No Play group took place before the experiment began while testing for the play groups took place on the fourth and fifth days of the experiment.

All play and testing sessions were videotaped. In addition, the researcher kept written records of subjects' procedures and answers in the testing sessions. During transcriptions of videotaped data, it was found that mechanical problems had occurred on one of the testing days, so videotape data for the testing sessions was abandoned in favor of the written records. Subjects' responses were scored on the basis of categories which described the procedures used by the subjects in solving each of the four problems. A check of the written record of the times taken to solve each problem was made using the videotape sound.

A one-way analysis of variance revealed no significant effects of the treatments on any of the criterion measures, scores on the four problems, and times taken to solve each of the four problems. Three two-way analyses of variance each tested the combined effects of treatment and one of three independent variables, school, time of kindergarten day, and order of presentation of problems on the criterion measures. Three significant effects are reported in Chapter IV. A three-way analysis of variance revealed no further main effects of treatment, school or time of kindergarten day on any of the criterion measures. Correlations between scores in all pairs of division problems were significant and positive. The correlations between scores and times of problems are reported in Chapter IV.

From the transcribed videotape play data, a rough examination was made of the play behavior of six highest scoring and six lowest scoring subjects. Features of the play behavior of each group are also described in Chapter IV.

Conclusions of the Study

The following conclusions are based on the data and analyses contained in Chapter IV.

1. Over the three day play period of the experiment,

neither the Free Play nor the Augmented Play treatments significantly influenced children's problem solving scores. From the examination of the play behavior of 12 subjects, there is a possibility in this study, that play level was a better predictor of ability in problem solving than the play exposure treatments. Future research would need to test this possibility using a stratified play level sample in studies which examine the effect of play upon problem solving ability.

2. There was a suggestion of an effect of the school upon the criterion measures. The relationship is uncertain but may lie either in the home background of subjects affecting play ability or cognition, or in the school program. One way to determine these possibilities may be through prior assessment of the play level and cognitive ability of incoming kindergarten children and testing the effect of a planned intervention play program in altering those levels.

3. The eight dependent variables in this study were the scores on the four test problems and the times taken to solve the four problems. The low correlations between these variables indicate that while scores were somewhat related in the test problems, more complex factors such as intelligence, concept understanding, perceptual distractions or level of concentration, which were not tested in this study, may have affected results. Further research would be needed to find which variables affect

children's problem solving.

4. Symbolic play, particularly at the thematic level, appears to be the kind of play related to successful problem solving. This finding, although only tentative and based on a rough description of the play behavior of a few subjects in this study, is in agreement with the literature. Further research is needed to substantiate this conclusion.

5. Features of the play behavior of successful solvers in this study in comparison with those less successful were higher levels of play, greater play concentration, more diverse responses, use of the constructive mode of play behavior and attempts at solving problems during play.

6. Older subjects may be better at problem solving than younger subjects, but this study did not seek to establish whether age was related to problem solving or play level. Further research would be needed to examine this exact relationship.

Implications for Education, Research, and Teacher Education

Several implications for curriculum content and teaching in the early childhood years can be drawn from the stated conclusions. They concern the developmental and environmental forces which propel children's cognitive growth.

In Piaget's (1969) view, the gap between action representation in thought is bridged through symbolic play. He noted that

> representation in action is then liberated from the sensori-motor requirements of direct perceptual copy and reaches an intermediary level where the action, detached from its context, becomes a differentiated signifier and consequently already constitutes in part a representation in thought. With symbolic play...this transition from representation in action to representation in thought is reinforced (p. 56).

During this period, the child's fullest means for representation may be the symbolic means which he develops himself in symbolic play. This "language" represents his understanding of concepts before he can represent them in thought.

Because the child thinks in this way, Bruner (1960) wrote that the teaching of any subject to children is the task of "representing the structure of that subject in terms of the child's way of viewing things." (p. 33). A failure to build a bridge of symbolic play during the preschool years may mean that some children, unprepared for symbolic school instruction, may experience failures over which they have no control. The resultant cognitive disadvantage may never be overcome.

Apparently, play programs of a short duration will have little effect on helping children develop problem solving skills. The amount of time needed for any effect to be noticed should be tested, in view of the research which suggests longer play programs.

The secondary consideration of play behavior seemed to suggest that some children did not grow in their play level in this study. The question of whether this is a characteristic of children who play at certain levels and if so, why, is a subject for future research.

Perhaps the lack of symbolic play among lower scoring subjects in this study may be rooted in home background, in a failure of adult models to help develop a predisposition to play. The strong influence of the maternal parent in infancy is noted by Ross, Rheingold, and Eckerman (1972) and the practices of early child rearing were found by Pulaski (1970) to be related to a predisposition to fantasy. Support for El'Konin's view that children will not progress from one level of play to another without specific adult modelling, is found in Feitelson and Ross (1973) and Smilansky (1968). Also, the evidence of teacher intervention in overcoming previous play deficiency, is clearly noted within longer experimental play programs (Lovinger, 1974; Rosen, 1974). There seems strong implication for the provision of adequate play settings which may aid symbolic play growth.

A further implication lies in the need to provide settings where children can socialize and learn from other children. Duckworth (1964) spoke of Piaget's belief that the root of children's thinking is in action which takes two directions, that of acting upon material things and that of group action in a collaborated effort. Social transmission aids the growth of objective thinking. Perhaps its best growth field is in symbolic play where interaction with other children, particularly those with previous symbolic play experience, provides play models.

The findings from research have strong implications in educating teachers for the role of both model and intervener in play. Almy (1967) pointed to the need to provide a balance between spontaneous and structured play settings. In addition, she reminded that the child's response to instruction is dependent upon his internal construction of knowledge. Although the play setting is the ideal place for intervention, teachers first need to diagnose the cognitive abilities of their pupils before providing this intervention.

Additional Research Considerations

The results of the study suggest further research is needed in the following areas.

The Effects of Time and Complexity of Play Setting

A complex play setting suitable for real-life problem solving was used in this study. However, the short play time allowed in the complex setting may have been insufficient for children to assimilate much information from the materials. Replications of this type of study and that of Sylva et al (1976) are needed to test play settings of varying complexity and the effects of time upon growth in problem solving ability.

The Effect of Play on Diverse Problems

Little research has been reported of the effect of play in solving a wide range of problems. The problems used in this study were of a specific nature. Perhaps descriptive studies of individual children in solving many different problems may be a starting point for discovering directions for research.

The Effect of Socialization

The concern of this study was the effect of individual play upon problem solving ability. Little research has tested the effects of social collaboration in play upon solving a variety of problems. This seems to be an important direction for research, for typical play settings in education generally consist of several children playing together. Both descriptive and experimental research is needed to isolate factors of social play which have a definite bearing upon play growth and problem solving. Of particular concern may be the effect of socialization upon language, objectivity and critical thinking within play.

Additional Variables

A number of variables which were not controlled in this study may have had an effect upon subjects' scores. Further knowledge of the effects of age, home background, intelligence, initial play level and school program on problem solving, need to be ascertained through a review of relevant research and then tested in experimental situations using stratified samples.

Play Level

A relationship appeared to exist between the scores of successful problem solvers in this study and the level of play exhibited during play sessions. However, the play of only a few subjects was examined and, as noted in the study, these subjects' scores were not always consistent. Further research might isolate the precise features of play behavior which achieve successful problem solving.

In conclusion, it would seem that a substantial program of descriptive and experimental research would be needed to isolate features of play which relate to ability in problem solving and to discover specific relationships between play and problem solving. Such a research program might provide a stronger foundation of information on which to base suggestions for classroom teaching and teacher education.

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APPENDIX A

PROTOCOLS

1. Animal Groups
2. Cargo Groups
3. The Problems

Animal Groups

The board is placed on a low table in front of the child so that he has an overview of it. Two piles containing 26 posts and 17 slats for fence building are placed on the side of the board and a box containing an assortment of 20 toy animals is placed between the child and the board. The child is shown how to fit the posts into the holes on the board designed to accommodate them. He is also shown how a slat fits between two posts to make a fence. The child is asked to build two more fences, like the one he was shown, anywhere on the board. When the child has completed these, he is asked to build a closed cage (corral, pen) to keep some animals in. If he has any difficulty constructing this cage, he is given assistance.

The child is then presented with the box of animals which includes four camels, four ducks, four mice, four hippopotamuses, an elephant, moose, horse and a lion. He is instructed to build enough cages for these animals with the specific directions that all the animals must be put in the cages, and that there are five animals in each cage. The child is asked, "If there are five animals in each cage, how many cages will you need for all these animals?" If the child encounters difficulty with the problem or appears to have forgotten the problem, he is reminded of the original question. Otherwise no comments are made about his performance. When he indicates that he has finished the task, the child is asked, "Are there five animals in each cage?"[1] "How many cages did you need to build?"

The animals are collected, two of the four camels are removed, and the remainder (18) are placed in the box. Cages are either dismantled or built so that three cages remain. The child is told that the remaining cages are for the animals in the box. He is asked to put all the animals in the cages so that there are the same number of animals in each cage. If the child has difficulty with this operation, appears to have forgotten the problem, or does not place all the animals in the cage, he is reminded of the original question. When the child appears to have completed the task to his satisfaction, he is asked, "Are there the same number in each cage?" "How many animals are there in each cage?"

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[1] This question has been changed from, "Are there the same number of animals in each cage?", the question used in Bourgeois' (1976) study.

Cargo Groups

The apparatus is placed on a table in front of the child who is standing or seated. The model is referred to and the child is shown the river, the islands, the ferry boat, the parking lots and the houses. There are fifteen plastic cars, four red, four blue and seven yellow, in the parking lot on one side of the river and three houses placed on the other side of the river. The child is first shown how the ferry can cross the river and is asked to choose a car, put it on the ferry, take it off the ferry, and park it in the parking lot on that side. Assistance is given the child with these moves if necessary. When they are completed, the car is returned to the first parking lot.

The child is then told that all the cars are to be taken across the river and parked in the second parking lot. He is advised that the ferry accommodates exactly three cars each trip and the following question is asked: "If the ferry boat can take only three cars each trip, how many trips must the ferry take to get all the cars across?" No assistance is given to the child except to repeat the original question if he puts an incorrect number of cars on the ferry boat or fails to take all the cars across on the ferry. When the child indicates he has finished the operation, he is asked: "Have you parked all the cars on the other side?" "How many trips did the ferry boat take?" If all the cars are not on the second parking lot they are now assembled there.

The child is asked then to park all the cars at the three houses so that there are the same number of cars at each house. If the partitioning operation offers some difficulty or he does not use all the cars, he is reminded of the original problem. When the child has parked all the cars, he is asked: "Does each house have the same number of cars?" "How many cars at each house?"

The Problems

Problem 1

Animal Groups Measurement Division

Build enough cages for all these animals so that there are five animals in each cage. How many cages will you need for all the animals?

Problem 2

Animal Groups Partitive Division

Put all of these animals into three cages so that each cage has the same number of animals. How many animals are in each cage?

Problem 3

Cargo Groups Measurement Division

Take all these cars across the river on the ferry boat and park them in the second parking lot. If the ferry boat can take only three cars each trip, how many trips must the ferry take to get all the cars across?

Problem 4

Cargo Groups Partitive Division

Park all of these cars at the three houses so that there are the same number of cars at each house. How many cars at each house?

APPENDIX B

SAMPLE WRITTEN RECORDS OF THE TESTING SESSIONS

School 1 Time AM

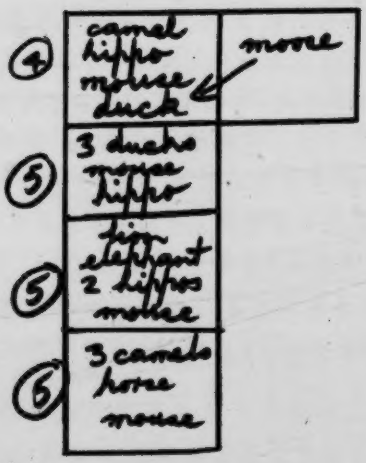
Name ID#26

Order of Testing 1

Birthday

Animal Groups Time 9.2 - 9.9.

1. Measurement


④
camel
hippo
mouse
duck
moose
⑤
3 ducks
moose
hippo
⑤
lion
elephant
2 hippos
mouse
⑥
3 camels
horse
mouse

- built 2 cages
- puts 1 2 3 4 5 animals in 1st cage, then 2nd, Counts.
- builds 3 more cages
- puts 5 in 1 cage, 4 in next, and 1 in a cage by itself

(Asked were 5 in cages)

- counts animals
- puts moose in with 4 animals
- now has 5

Answer given - 5 cages

2. Partitioning Time 9.10 - 9.11

⑥	⑥	⑥
elephant 3 hippos moose duck	hippo 2 mice lion horse duck	2 mice 2 ducks 2 camels

- puts 3 animals in 1st cage, 3 in 2nd, 3 in 3rd.
- puts 3 more into 1st cage, 2nd cage, 3rd cage.

(Question - same no?)

No

- Counts 1 2 3 4 5 6 in 1st cage then 1-10, 1-11 - counts other 2 cages together

(How many in each?) Counts 6

Answer, 6, 6, 6.

Name ID# 26

Order of Testing 2

Cargo Groups Time 9.11.5 - 9.13.5.

1. **Measurement**

Trips
1. r. b. y
2. b. b. y
3. r. b. y
4. y. y. r
5. y. y. r.

- no speech
- takes 3 each trip
- takes ferry straight over & parks cars

Answer - 5 trips

---

2. **Partitioning** Time 9.14 - 9.16

2 b.
1 r
1 y
⑥
+ b + r

④
1 r
1 b
2 y.

4 y
1 r
⑤

- places 1 car at each house - stops
(Reminder - repeat question)
- places other cars at houses except 2
- has 4 at 2 houses
5 at 1 house
(Are there the same no?)
Shakes head
- places 2 more at 1st house
(Same?) Says uh, uh.
Nods - doesn't count
— 3.

Answer - 3 each.

APPENDIX C

LETTER TO PARENTS

University of Alberta,

Edmonton.

Dear Parent,

I am a graduate student from the University of Alberta, conducting research on children's play. During the next three weeks, I will be working with some of the kindergarten children from ___________ school in fifteen minute individual play sessions.

As all play sessions will be videotaped, I require parental permission before I proceed with the research, which will be conducted within the school itself. Information gained from filming children will be used solely for this piece of research and not made available for any other persons.

Yours sincerely,

J. Rice.

Please detach and return as soon as possible to your child's kindergarten teacher.

I hereby give permission for my child ________________________ to take part if he/she is selected, in the research project being conducted at __________ school.

Signed ________________________

APPENDIX D

FREQUENCY SCORES FOR THE FOUR TEST PROBLEMS

Table 8

Scores on Problem 1

Range 1-8 N=45 (15 per treatment group)

Mean = 3.5333 S.D. = 2.0827

	Treatment Group			
Score	Control No Play	Free Play	Augmented Play	Total
1	7	3	4	14
2	0	2	0	2
3	2	1	1	4
4	3	3	4	10
5	2	2	1	5
6	1	3	3	7
7	0	1	1	2
8	0	0	1	1
Mean	2.7333	3.8000	4.0667	

Table 9

Scores on Problem 2

Range 1-8 N=45 (15 per treatment group)

Mean = 5.4667 S.D. = 1.7588

	Treatment Group			
Score	Control No Play	Free Play	Augmented Play	Total
1	1	0	0	1
2	1	1	0	2
3	3	0	1	4
4	2	2	3	7
5	2	4	1	7
6	1	1	1	3
7	5	7	8	20
8	0	0	1	1
Mean	4.7333	5.6667	6.0000	

Table 10

Scores on Problem 3

Range 1-8 N=45 (15 per treatment group)

Mean = 3.9556 S.D. = 1.5341

	Treatment Group			
Score	Control No Play	Free Play	Augmented Play	Total
1	1	0	0	1
2	4	5	2	11
3	0	1	0	1
4	7	6	5	18
5	3	1	4	8
6	0	0	2	2
7	0	2	2	4
Mean	3.4667	3.7333	4.6667	

Table 11

Scores on Problem 4

Range 1-8
N=45 (15 per treatment group)
Mean = 4.4667
S.D. = 2.3814

	Treatment Group			
Score	Control No Play	Free Play	Augmented Play	Total
1	1	0	0	1
2	6	5	6	17
3	1	0	2	3
4	1	0	0	1
5	0	1	1	2
6	3	5	3	11
7	1	1	1	3
8	2	3	2	7
Mean	4.0667	5.0667	4.2667	

APPENDIX E

FREQUENCY OF TIMES FOR THE FOUR TEST PROBLEMS

Table 12

Times Taken on Problem 1

N = 45

Mean = 8.8 S.D. = 4.0213

	Treatment Group		
Times	Control No Play	Free Play	Augmented Play
0- 5 mins	2	3	3
6-10 mins	8	8	9
11-15 mins	5	3	3
16-20 mins	0	0	0
21-25 mins	0	0	0
26-30 mins	0	1	0
Mean mins	9.0667	9.0667	8.2667

Table 13

Times Taken on Problem 2

N = 45

Mean = 2.5 S.D.= 1.7764

	Treatment Group		
Times	Control No Play	Free Play	Augmented Play
0.5- 3 mins	14	11	10
3.5- 6 mins	1	2	5
6.5- 9 mins	0	0	0
9.5-12 mins	0	1	0
12.5-15 mins	0	1	0
Mean mins	2.1	2.8	2.6

Table 14

Times Taken on Problem 3

N = 45

Mean = 2.8111 S.D. = 1.7929

	Treatment Group		
Times	Control No Play	Free Play	Augmented Play
0.5- 1 mins	2	3	4
1.5- 2 mins	1	5	4
2.5- 3 mins	8	6	1
3.5- 4 mins	3	0	2
4.5- 5 mins	0	0	2
5.5- 6 mins	0	0	1
6.5- 7 mins	0	1	0
7.5- 8 mins	1	0	1
Mean mins	3.0000	2.4000	3.0333

Table 15

Times Taken on Problem 4

N = 45

Mean = 2.8444 S.D. = 3.3147

	Treatment Group		
Times	Control No Play	Free Play	Augmented Play
0.5- 3 mins	12	14	11
3.5- 6 mins	2	0	3
6.5- 9 mins	1	1	0
9.5-12 mins	0	0	0
12.5-15 mins	0	0	0
15.5-18 mins	0	0	0
18.5-21 mins	0	0	0
21.5-24 mins	0	0	1
Mean mins	2.6333	2.3667	3.5333

APPENDIX F

TWO-WAY ANALYSIS OF VARIANCE

Effect of School by Treatment on Eight Dependent Variables

Table 16

Variable 1 - Scores on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (School)	1.28928	1	.313807	.57856
B (Treatment)	17.1452	2	2.08654	.13775
AB	18.7452	2	2.28125	.11563
Error	160.233	39		

Variable 2 - Scores on Problem 2

Source	S.S.	d.f.	F-ratio	Probability
A (School)	6.00357	1	1.97079	.16828
B (Treatment)	13.4595	2	2.20918	.12335
AB	1.45952	2	.239559	.78812
Error	118.805	39		

Variable 3 - Scores on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (School)	5.61944	1	2.52266	.12030
B (Treatment)	12.1722	2	2.73215	.07754
AB	1.50555	2	.337934	.71531
Error	86.8760	39		

Table 16 (cont).

Variable 5 - Times on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (School)	11.2000	1	.668409	.41857
B (Treatment)	6.43115	2	.191904	.82616
AB	56.6089	2	1.68919	.19790
Error	653.492	39		

Variable 7 - Times on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (School)	1.11468	1	.328869	.56962
B (Treatment)	3.46448	2	.511071	.60381
AB	7.53115	2	1.11097	.33943
Error	132.188	39		

Variable 8 - Times on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (School)	.0063492	1	.0005296	.98176
B (Treatment)	9.48888	2	.395732	.67586
AB	15.6222	2	.651521	.52683
Error	467.572	39		

APPENDIX G

TWO-WAY ANALYSIS OF VARIANCE

Effect of AM/PM Time by Treatment on Eight Dependent Variables

Table 17

Variable 1 - Scores on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	5.43214	1	1.27225	.26624
B (Treatment)	14.5389	2	1.70256	.19548
AB	8.31666	2	.973915	.38660
Error	166.519	39		

Variable 2 - Scores on Problem 2

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	7.55714	1	2.55570	.11797
B (Treatment)	12.0103	2	2.03084	.14487
AB	3.38809	2	.572899	.56856
Error	115.322	39		

Variable 3 - Scores on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A(Time)	4.29206	1	1.87475	.17877
B (Treatment)	12.1556	2	2.65474	.08300
AB	.422222	2	9.22123	.91211
Error	89.2866	39		

Variable 4 - Scores on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	18.0036	1	3.12531	.08491
B (Treatment)	7.60238	2	.659865	.52260
AB	4.13571	2	.358968	.70068
Error	224.662	39		

Table 17 (cont).

Variable 5 - Times on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	1.22232	1	.0719374	.78995
B (Treatment)	9.10139	2	.267823	.76644
AB	57.4124	2	1.68945	.19785
Error	662.666	39		

Variable 6 - Times on Problem 2

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	1.80803	1	.524103	.47342
B (Treatment)	4.01845	2	.582423	.56333
AB	1.75179	2	.253899	.77704
Error	134.541	39		

Variable 7 - Times on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	2.20248	1	.622981	.43471
B (Treatment)	3.86250	2	.546262	.58348
AB	.751389	2	.106267	.89944
Error	137.880	39		

Variable 8 - Times on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (Time)	.952778	1	.0805380	.77807
B (Treatment)	13.2722	2	.560949	.57520
AB	20.8722	2	.882161	.42198
Error	461.376	39		

APPENDIX H

TWO-WAY ANALYSIS OF VARIANCE

Effect of Order of Presentation by Treatment on Eight Dependent Variables

Table 18

Variable 1 - Scores on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	1.57500	1	.346299	.55961
B (Treatment)	15.0055	2	1.64965	.20524
AB	1.31667	2	.1447449	.86570
Error	177.376	39		

Variable 3 - Scores on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	.381349	1	.163530	.68814
B (Treatment)	11.7389	2	2.51694	.09374
AB	2.67222	2	.572952	.56853
Error	90.9470	39		

Variable 4 - Scores on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	8.57500	1	1.46482	.23345
B (Treatment)	8.58809	2	.733528	.48672
AB	9.92143	2	.847411	.43626
Error	228.304	39		

Table 18 (cont).

Variable 5 - Times on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	3.54375	1	.217194	.64378
B (Treatment)	3.69702	2	.113294	.89318
AB	81.4303	2	2.49540	.09554
Error	636.327	39		

Variable 6 - Times on Problem 2

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	3.21428	1	.991869	.32543
B (Treatment)	3.36845	2	.519721	.59875
AB	8.50178	2	1.31175	.28097
Error	126.385	39		

Variable 7 - Times on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	.0834325	1	.0265204	.87148
B (Treatment)	4.19127	2	.666133	.51944
AB	18.0579	2	2.87001	.06874
Error	122.693	39		

Variable 8 - Times on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (Order)	20.8099	1	1.91182	.17463
B (Treatment)	13.9478	2	.640697	.53238
AB	37.8811	2	1.74008	.18886
Error	424.510	39		

APPENDIX I

THREE-WAY ANALYSIS OF VARIANCE

Effect of School by Time by Treatment on Eight Dependent Variables

Table 19

Variable 1 - Scores on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (School)	2.32692	1	.579163	.45204
B (Time)	6.94231	1	1.72792	.19774
AB	8.48077	1	2.11083	.15570
C (Treatment)	17.5897	2	2.18901	.12803
BC	6.82051	2	.848801	.43706
AC	19.1282	2	2.38047	.10821
ABC	5.58974	2	.695634	.50592
Error	132.585	33		

Variable 2 - Scores on Problem 2

Source	S.S.	d.f.	F-ratio	Probability
A (School)	6.70085	1	2.13304	.15361
B (Time)	8.21367	1	2.61461	.11540
AB	.547008	1	.174126	.67917
C (Treatment)	12.5940	2	2.00449	.15080
BC	3.00427	2	.478166	.62415
AC	1.20940	2	.192491	.82582
ABC	2.90171	2	.461842	.63413
Error	103.668	33		

Table 19 (cont)

Variable 3 - Scores on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (School)	6.70085	1	2.87173	.09957
B (Time)	5.34188	1	2.28933	.13979
AB	.854700	2	.366292	.54917
C (Treatment)	13.4145	2	2.87448	.07066
BC	.696581	2	.149264	.86192
AC	1.79914	2	.385522	.68312
ABC	3.49145	2	.748151	.48110
Error	77.0017	33		

Variable 4 - Scores on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (School)	10.1731	1	1.96800	.17000
B (Time)	20.9423	1	4.05132	.05236
AB	3.25000	1	.628717	.43349
C (Treatment)	8.62820	2	.834568	.44302
BC	3.47436	2	.336060	.71700
AC	30.9359	2	2.99229	.06394
ABC	8.24359	2	.797367	.45900
Error	170.585	33		

Table 19 (cont)

Variable 5 - Times on Problem 1

Source	S.S.	d.f.	F-ratio	Probability
A (School)	16.7356	1	1.09818	.30228
B (Time)	4.04327	1	.265318	.60992
AB	75.1201	1	4.92935	.03339
C (Treatment)	8.58013	2	.281512	.75644
BC	57.1762	2	1.87594	.16919
AC	61.5416	2	2.01917	.14884
ABC	14.2917	2	.468907	.62979
Error	502.898	33		

Variable 6 - Times on Problem 2

Source	S.S.	d.f.	F-ratio	Probability
A (School)	17.8894	1	6.33779	.01685
B (Time)	3.00481	1	1.06453	.30969
AB	1.73558	1	.614873	.43855
C (Treatment)	5.54166	2	.981639	.38537
BC	3.09936	2	.549014	.58270
AC	5.09936	2	.903290	.41502
ABC	18.7724	2	3.32531	.04835
Error	93.1477	33		

Table 19 (cont)

Variable 7 - Times on Problem 3

Source	S.S.	d.f.	F-ratio	Probability
A (School)	.942307	1	.246546	.62281
B (Time)	1.92308	1	.503155	.48310
AB	.0769230	1	.020126	.88805
C (Treatment)	3.00961	2	.393719	.67767
BC	.355769	2	.0465418	.95459
AC	7.87500	2	1.03021	.36813
ABC	3.52884	2	.461644	.63425
Error	126.127	33		

Variable 8 - Times on Problem 4

Source	S.S.	d.f.	F-ratio	Probability
A (School)	.00213675	1	.0001731	.98958
B (Time)	.617521	1	.0500178	.82441
AB	6.46367	1	.523543	.47443
C (Treatment)	8.90171	2	.360509	.70003
BC	15.0812	2	.610772	.54896
AC	15.9273	2	.645040	.53113
ABC	34.1581	2	1.38337	.26489
Error	407.418	33		

APPENDIX J

SAMPLE PLAY TRANSCRIPTIONS
LOW AND HIGH SCORING SUBJECTS

Sample - Low Scoring Subject

Subject - K. ID # 16 School 1

Monday

K. is lying before Cargo Groups. Says "there, look at that - beep". Drives cars around first parking lot. "Stupid man." Glances towards camera. Singing. Lines up cars side by side, making car noises, muttering to himself. Pushes car into another one. "Smash - boing." Finishes lining up cars, says "there now, they're all lined up." Asks if I know what they're for. Drives one car up road, looks at me, says, "Watch this, gona smash up." He pushes different cars around the parking lot randomly, now smashes them into each other. Says, "there, got red one." Makes a noise like a gun. "That pops the red one." Knocks another car into same car, making smash noises. "They're helping this car - doesn't want him to get hurt. Two cars together." Smashes another car in as he says this, still making noises like engines and crashes. Now drives two cars together, down road towards parking lot. Says, "cars go there", points to ferry and island. "This car's down here, can't stay over there," car is on ferry, "has to stay there." Taps finger on parking lot - pause in action.

"Gona have two police cars," takes two cars, drives them, making siren noise and lines up sideways, other cars lined up as well. "They're gona have a race now. Oh boy, police cars. There's one, two, three." He places them into a line and squeals as he continues lining up.

Sample - Low Scoring Subject

Subject - A. ID # 21 School 1

Wednesday

Cargo Groups

A. looks at the cars, picks up each one at a time, looks at them, calls two, "speeding car, rush car," places them on parking lot. Says "these two cars are going to go away," Lifts up ferry, up then down, places it on water. Discusses family with me - her sister, mother, her games at home, order of children. Partitions cars on first parking lot into colors. Stands up, walks around to second parking lot, kneels down and partitions those cars into colors, but they have no space between them. One car falls into water, says "One drownded," and pushes another car into water. Asks questions about islands.

Changes games. Animal Groups. Picks up four pegs and places in holes, then counts them. Says, "I'm making apartment." "These are for animals' cage." Picks up animals from box, one by one, placing them between pegs which are set in group of four. Places animals in families, stands up those that fall. Says, "Mouse-man is looking at the animals." Animals are the hippopotamus and elephant. Puts animals back into box. Packs up pegs. Terminates play.

Sample - High Scoring Subject

Subject - C. ID # 41 School 2

Tuesday

Cargo Groups

Drives cars onto ferry near first parking lot, makes engine noises. Loads 4 cars, lines up rest of cars in one line ready for the ferry. Drives the ferry to first island, parks at shore, drives cars off and parks them, making brake noises. Returns ferry to parking lot, driving it back. Leans over to reach second ferry, steers to island, loads same cars and drives them to second island in middle of river. Loads four cars onto first ferry and two fall into water. Says, "These drownded, have to get help first." Takes a block, places it in river beside ferry, lifts car out of water, placing back onto parking lot, then again drives onto ferry. (Asked if block was a crane?) "No." Takes four more cars onto second ferry from the island, and says they're going somewhere. Plans first parking lot as Saskatoon, the other side of the river as Edmonton and all the cars are on their way to Meadowlark. Many cars on Edmonton side of river, drives second ferry to join other ferry at shore, bringing cars from the island. (Question about the ferry). "The ferry comes every day and Sunday. It picks up four today and four. That makes eight.

Later.

Driving cars back and forth along the road. Uses white block, flies up in air towards river, "Here comes a sweeper." He sweeps two cars into the river with the block. Other two blocks are brought to rescue them. (What will you use?). "Helicopters. They bring them back to the grass. Helicopters are the only ones which can land in water, boats can't." Uses blocks as helicopters, swoops down and scoops cars with both hands, places back onto one ferry. Some of the cars are lying upside down on the parking lot. Says, "This is a police ferry boat. These are going back to Calgary, even ones which will stay here." Takes ferry across to island, visits there then across to other side of river. Cars are driven off ferry and around the lot, making driving noises - "even cars on grass," drives cars onto grass, seem to be parking there. Says he is taking these cars to Saskatoon 'cause some people are building new stores there now. (Suggestion of blocks to use as store). C. brings blocks over from other side of river, says, "There's one, there's two, there's three" as he places them in line together. "Oh all the stores are crowded." Play continues.

Sample - High Scoring Subject

Subject - S. ID # 45 School 2

Wednesday

Animal Groups

S. is placing pegs into holes on outskirts of board, "Gona make a great big square one (fence), not gona put any in these." He points to the intermediate holes. "Gona make a great big square one." Pegs are placed around the edge of the board. (Question - You don't have to use all the holes?) "No." Leans over to reach far side - placing pegs. Singing to himself. Starts to slide in slats one by one all around the edge of fence. Moves a pile of slats closer. Discussion of school social from previous night. Still singing, now has finished fence. Says, "It's a great big - now it's a great big -" Seems lost for a word. (I suggest house). S. says it's a farm or a zoo. "If I could knock two of these..." Just sitting, pensive, observing the huge fence, seems to be considering a course of action. Mumbling to himself, then removes two slats, asks how he is going to get into the middle with the fence closed. Seems to want to build something in the middle. (Do you have to go all the way into the middle?) Turns attention to corner, considers a moment, replaces slats on fence, says, "Maybe..just one," as he picks up two pegs. Places one peg in hole adjacent to corner of farm or zoo. Forms cage at corner, joining with two slats. Makes cage taller by placing more slats on top of first ones. Tries to place a slat across the top, straightways, but it fails to reach the sides for support and falls. Mutters, "How am I going to make a roof. Tries with slat again, moves around gradually, finds it fits across corner. Uses several slats to cover the whole roof. Says, "I'd better not bash it. Doesn't take very long to make." Takes the box of animals, peers in and selects animals one by one. Places animals one at a time into the cage, leaning over to see in. Humming. "Now camels, got lots of room to run about and play....and let's look." Leaning over closer, peering into doorway as he places them upright. "Walking, playing around...stuff they want to do." Play continues.